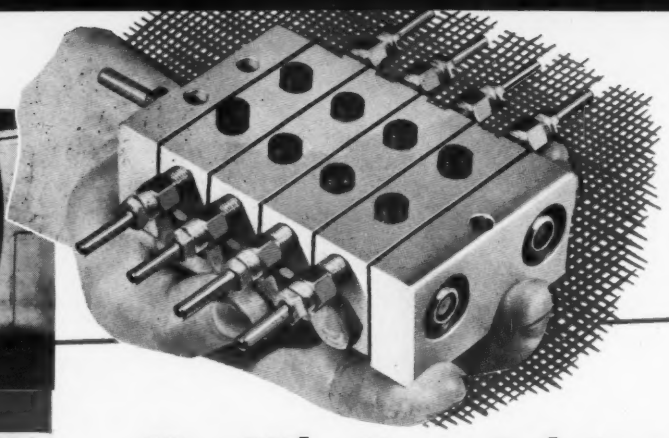
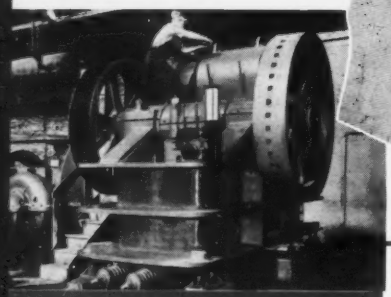
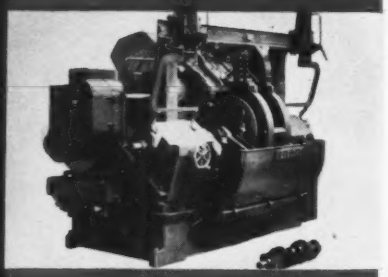
Lubrication ENGINEERING

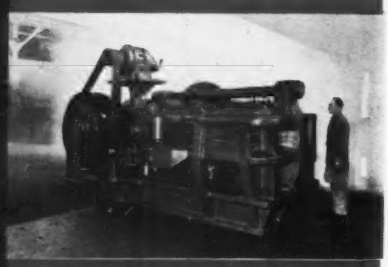
JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS



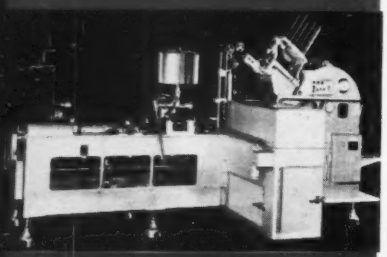


COAL AND ORE CRUSHERS

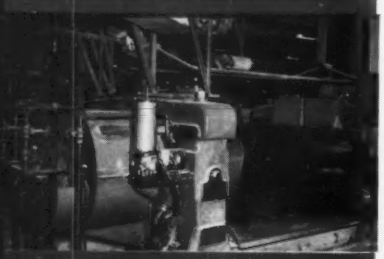


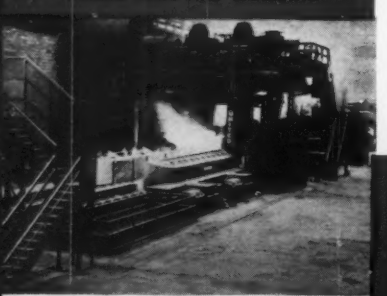


PRESSES AND UPSETTERS



CANNING AND CONTAINER MACHINERY





STEEL MILL EQUIPMENT

Men Who Know Lubricating Systems *Specify Trabon*

Check these Operating Features and you'll realize why plant engineers and master mechanics prefer Trabon

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- **Only One Indicator to Check**—The single indicator at the pump tells the whole story, giving positive proof when *every* bearing has received its full measured amount.
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Trabon Centralized Lubricating Systems can save you $5 to $8 per bearing per year in man-hours of lubricating time alone! Upwards of 100 bearings can be lubricated from one pumping point in a few moments time. Consistent lubrication will slash your repair bills and eliminate down-time. Write or phone today for detailed information.

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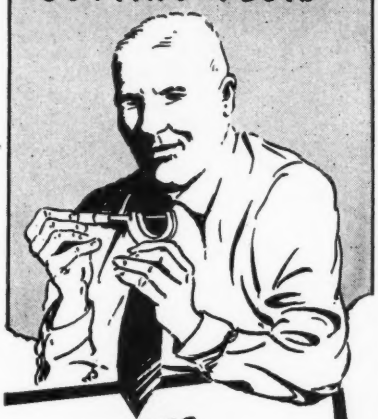
"THERE JUST ISN'T ANY 'ONE-SHOT' CUTTING FLUID"



...says "CHIP" WRIGHT

"You know, I've been around shops a long time and I've seen more than one man who thought he had a cutting fluid that could be used for everything. But, it just doesn't work that way. When you overdo standardization or simplification, trouble develops. Speeds, feeds, materials, tolerance and finish requirements all help determine the correct cutting fluid for the job. Because of this, I have found it best to rely on the recommendations of experienced cutting oil people. It's false economy to over-standardize or over-economize when it comes to cutting fluids."

—Chip

A Word About SOLVOL water-mixed cutting compound

SOLVOL, D. A. Stuart Oil Company's modern water-mix compound, will solve some of your machinery problems, eliminate some of your headaches. SOLVOL is more than just a high grade emulsifiable cutting fluid. It is a unique product incorporating extra cutting qualities which enable it to perform metal cutting jobs beyond the scope of other soluble products. Write for SOLVOL Booklet.

Another Time-Tested Stuart Product

D.A. Stuart Oil Co.

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Lubrication Engineering

VOL. 4 JUNE, 1948 NO. 3

In This Issue

The Editor's Page 117

Lubrication Engineering Education—by Dudley D. Fuller 118

Filtration of Insulating Oil Through Adsorbent Materials—by E. M. Kipp 122

Mechanism of Action of Bearing Corrosion Inhibitors in Crankcase Lubricants—by J. D. Guttenplan and C. F. Prutton 125

Lube Spots—Feature 132

Convention Highlights 133

News of Industry and Personnel 137

News of the Sections 140

Section Officers 141

Patent Abstracts, Oils and Lubricants 144

Advertiser's Index 148

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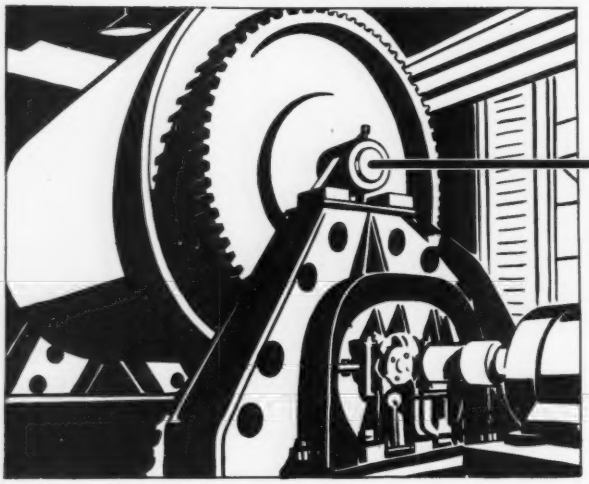
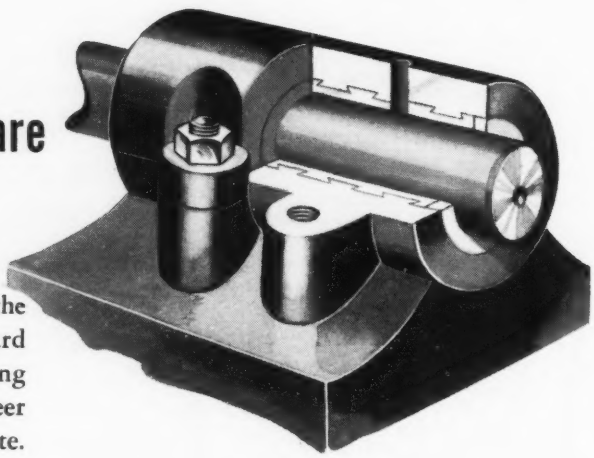


this bearing

needs special care



Every bearing needs care... and the tougher the service, the greater the care. The first step toward proper care of bearings . . . or other moving parts... is to have a trained lubrication engineer analyze the conditions under which they operate.

When a Swan-Finch lubrication engineer surveys your plant and equipment, he considers clearances, loads, operating temperatures, speed and other conditions that affect lubrication. From this analysis he recommends the *right* lubricant and its most efficient application . . . to reduce friction, to increase life of wearing parts and to cut maintenance costs.

Whenever two surfaces in contact move in relation to each other there is a lubrication problem. Whatever the problem, there is a specific Swan-Finch oil or grease to do the lubrication job as it should be done. Swan-Finch lubrication engineering service is available without obligation to make recommendations. For more information, address

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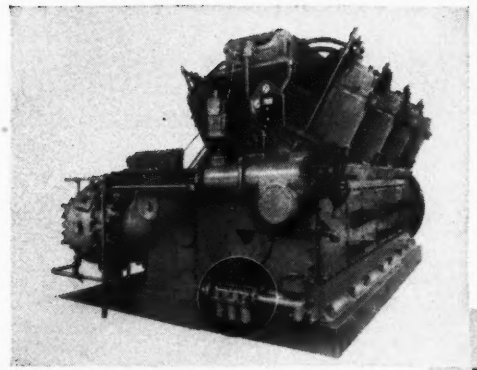
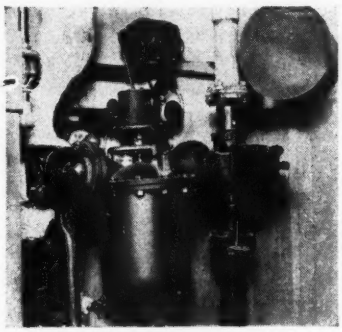
SERVING . . . *Steel • Metalworking • Textile • Plastics • Automotive Industries*

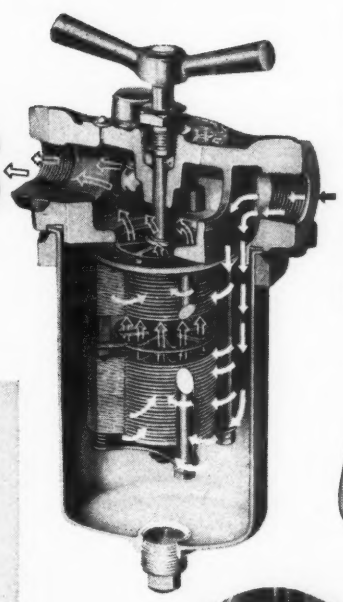
Cleans every drop ...without stop

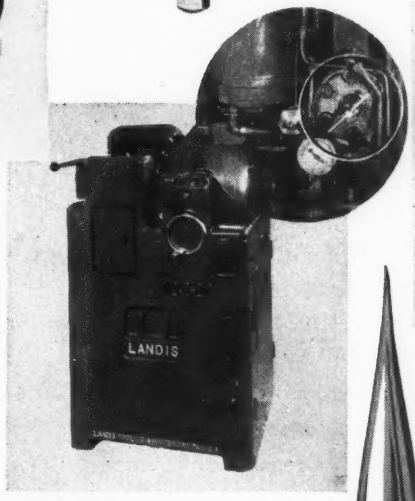


CONTINUOUS CLEANING is why this Diesel manufacturer selected Cuno Auto-Klean Filters as standard equipment. Externally-mounted all-metal filters are cleaned—without stopping flow—by periodic turning of handle.

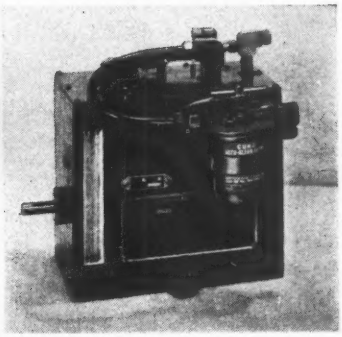


AUTOMATIC FILTER CLEANING by motor drive is used in this installation where soap is filtered at 300 lb per minute by Cuno Auto-Klean, an application where pressure loss must be minimum.





COMPACTNESS of Cuno Auto-Klean appealed to designers of this high-speed grinder. Built-in cartridge handles full flow of hydraulic system in same space as usual partial-flow type.



POSITIVE REMOVAL not only of metal chips, fine dust, and powder but also of water, from lubricating oil, protects printing presses, special machinery, etc., serviced by this Automatic Lubricator.

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FOR FREE INFORMATION ON *CONTINUOUS CLEANING*

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REMOVES MORE SIZES OF SOLIDS FROM MORE TYPES OF FLUIDS

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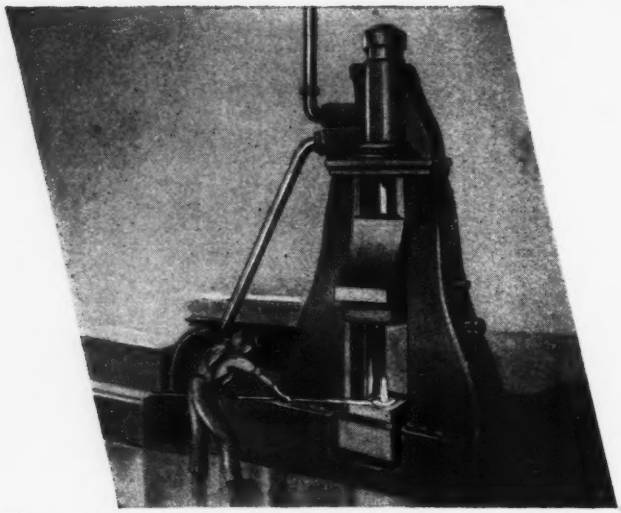

High Temperature Lubrication... 400° F. and UP!

Oil simply burns up when used to lubricate deep-impression forging dies. However, in the case of a midwest forge company a **"dag"** colloidal graphite dispersion produced a successful lubricant and a sharp reduction in costs.

If you have equipment operating at high temperatures, consult Acheson Colloids' engineers. They can probably make money-saving recommendations. Let them try . . . let them know your lubrication problem today. Check the coupon and mail with your name and address.

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- ☐ Extreme (high or low) temperature lubrication
- ☐ Parting
- ☐ Impregnation
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FF 12

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40th Anniversary Year

dag COLLOIDS

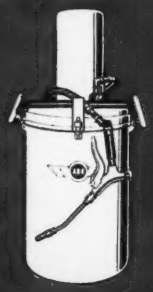
Save time with ARO lube equipment

Model 78 Visi-Flusher

Model 2800 Air Operated Grease Gun

Electric Lubricator Model 2534

Model 2647 Heavy Duty Grease Gun with Filler



Model 2160 Air Powered Lubricator

Model 2130 Bucket Type Lubricator

Model 2691 Transfer Pump

Portable Model 51-S Drum Cover Type

Model 2202 Heavy Duty Drum Pump

Grease Fittings

In today's heavy production, lubrication is tremendously important. Aro's expertly engineered complete line of lubricating equipment has been designed to increase efficiency with less maintenance time and expense. A few of the items in the Aro line are shown here.

Send for details of Aro's complete line

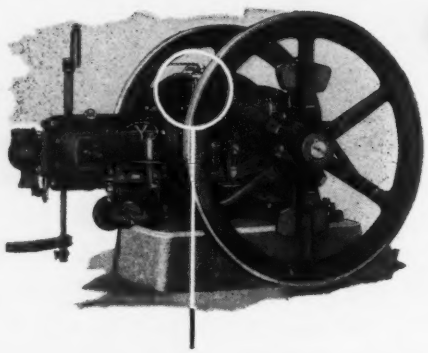
LUBE EQUIPMENT AND AIR TOOLS FOR INDUSTRY... AUTOMOTIVE... FARM

ARO

The Aro Equipment Corporation, Bryan, Ohio

Madison-Kipp
LUBRICATORS

from "OLD TIMERS"



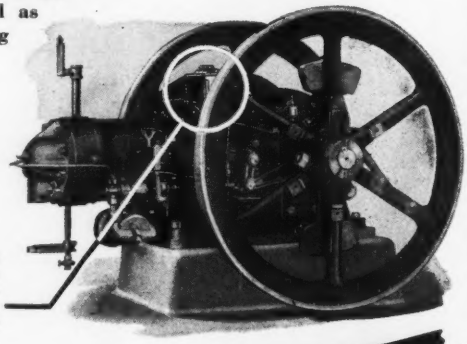
20 H. P. Fairbanks-Morse Type "Y" Oil Engine with side injection head produced in early nineteen hundreds. Note the Madison-Kipp Lubricator mounted on top of engine.

Like The Two Oil Engines Illustrated . . . to the Present Superb Engines, Machine Tools, and Compressors

MADISON-KIPP lubricators have provided positive fresh oil lubrication in measured quantities to millions of bearings in the fifty years since our beginning in 1898.

This long-time experience, we believe, has been the basis of sound progress. No better proof of progress can be offered than the fact that Madison-Kipp lubricators have been used as standard equipment by a long list of America's best manufacturers for 20—30—40 years and longer.

If you have an original equipment fresh oil lubricator problem, we will be glad to have an opportunity of presenting our solution.



25 H.P. Fairbanks-Morse Type "Y" Oil Engine with center injection head. It, too, was an early nineteen hundred model and was equipped with a Madison-Kipp Lubricator.

"Our 50th Year"

MADISON-KIPP CORPORATION

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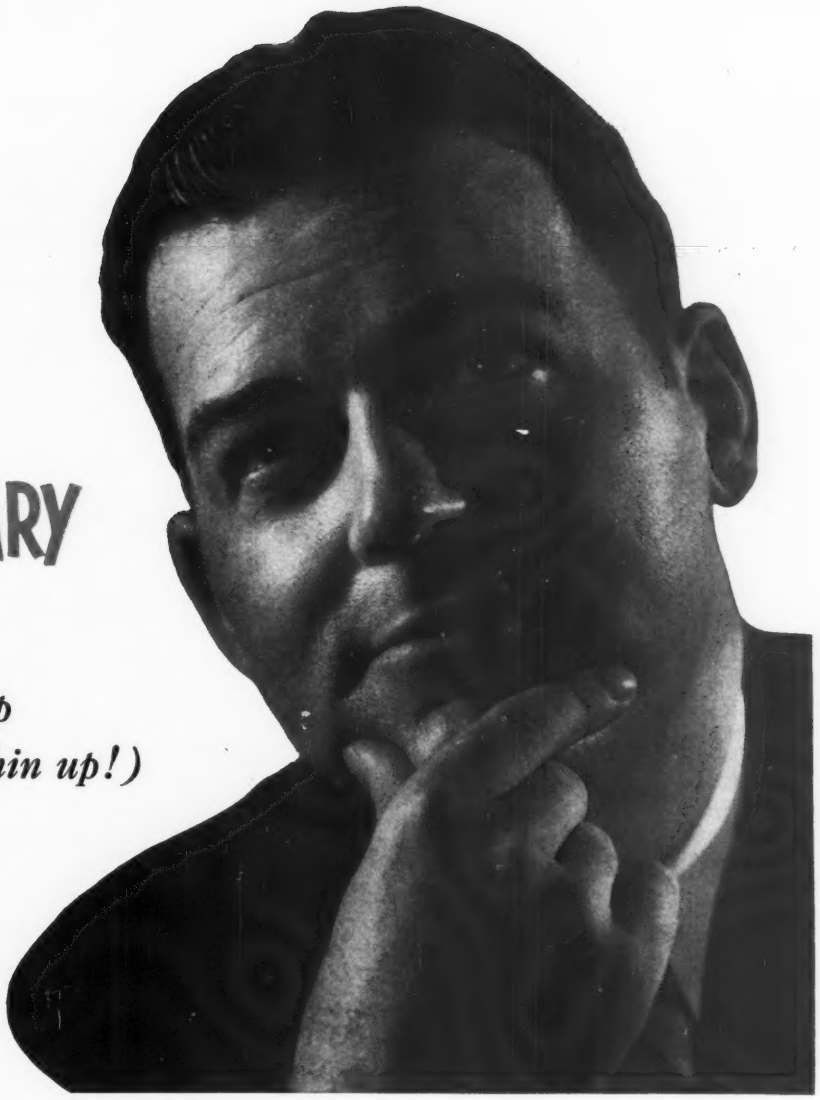
WM COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really* High Speed AIR TOOLS

Portrait of a man in an

OIL QUANDARY

(Houghton can help him keep his chin up!)



Too much down-time in Department "A"? Production slowed down in Department "B"? Too many lubes in your store-room, confusing maintenance men and running up lubrication costs?

Sounds like you need H.E.L.P.*

Why not let Houghton take over your worrying? We're qualified for it, on these counts:

Over half a century of accumulated experience . . . An able force of technically trained lube engineers available in every major industrial sector . . . a selection of modern lubricants, fortified by science to enable each variety to handle more jobs, thus reducing the number of items required . . .

And finally, a complete H.E.L.P.* which can be tailored to your plant's needs. This plan includes more than the conventional "survey". It is based on a study of *your* lubrication problems, boiled down into a workable solution which saves your plant money by decreasing expensive "down-time" and by enabling you to use "Less Oil—Less Often". So, to get *out* of an oil quandary, why not contact E. F. Houghton & Co., 303 West Lehigh Avenue, Philadelphia 33, Pa., and all principal cities.

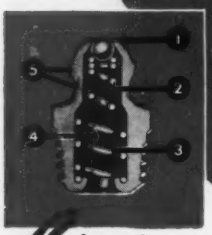
Ask the Houghton Man to show you

* **HOUGHTON'S ENGINEERED LUBRICATION PLAN**

Announcing the New and Improved

LINCOLN
KLEENSEAL FITTING
BULLNECK TYPE

The Modern Fitting with a BALL IN THE TOP...



Check These Features:

1. . . **Flush Ball Check** — Head can be wiped clean without forcing dirt into fitting and into bearing.
2. . . **Large Grease Passage**—The larger internal diameter permits greater flow of lubricant.
3. . . **Special Spring Design**—Spring cannot be compressed to restrict flow of the heaviest lubricants.
4. . . **Greater Flow—Less Resistance**—The larger internal area requires less pressure to clear the fitting.
5. . . **Sturdier Construction**—Enlarged neck size and projecting locking pad protect against damage and wear.

These Grease Fittings (Bullneck Type), were originally developed by the Lincoln Engineering Company for the United States Army Ordnance Department. They incorporate the most desirable characteristics of former types of high-pressure fittings and permit standardization of one, all-purpose fitting (Bullneck Type). They represent the first major improvement in grease fitting design that does not obsolete couplers and grease guns in general use today—they can be securely contacted by all commercial hydraulic couplers.

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Leaders in Lubricating Equipment for a Quarter Century

LINCOLN

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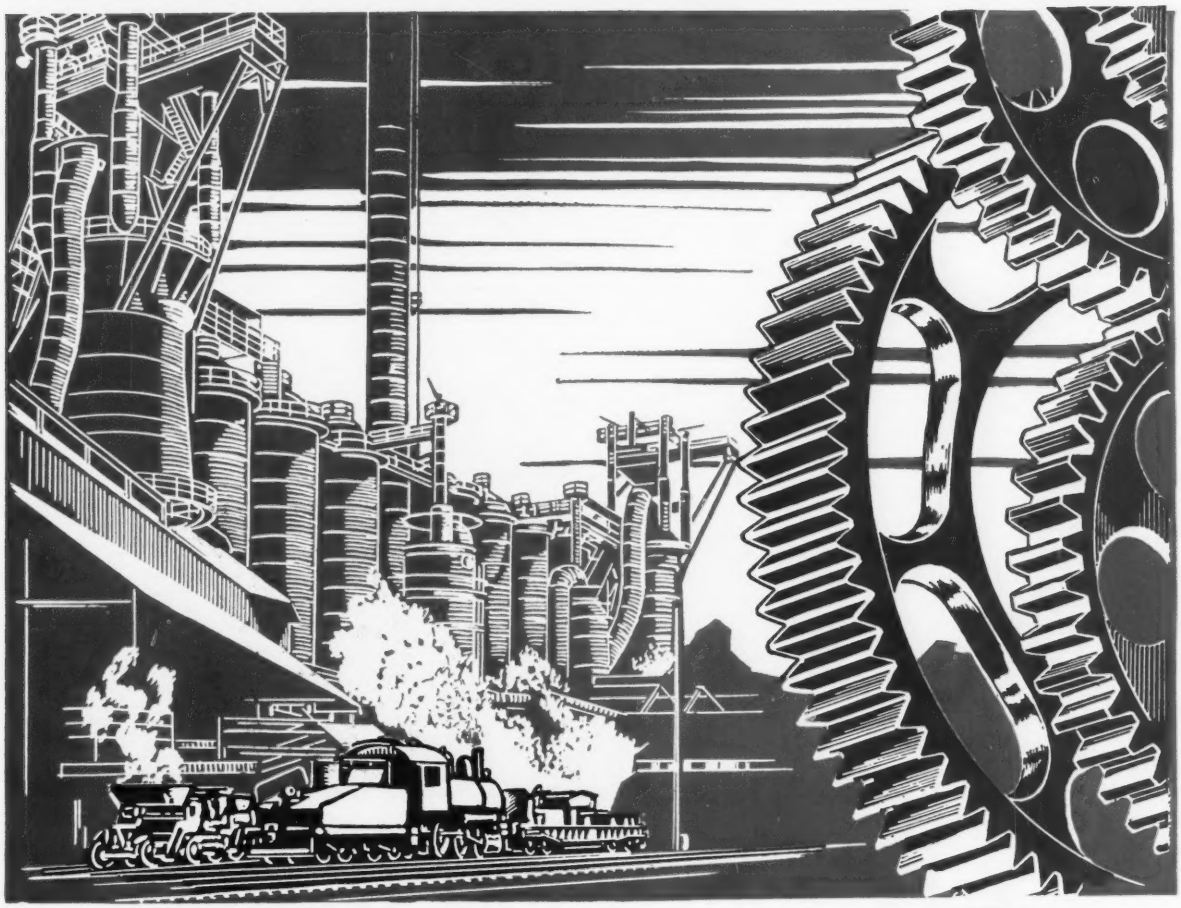
• APPLY THE RIGHT LUBRICANT
• IN THE RIGHT QUANTITY
• AT THE RIGHT TIME

YES! Tycol "Engineered Lubrication" performs better . . . BETTER . . . BETTER



Tycol Engineered Lubrication performs better because:

. . . *Tycol Engineered Lubrication* is scientifically engineered to meet every service condition in modern industry, no matter how extreme or unusual.

. . . *Tycol Engineered Lubrication* helps you "get it done" faster and more efficiently . . . production jumps when you switch to a Tycol oil or grease.

. . . *Tycol Engineered Lubrication* means new economies for you . . . by cutting repair bills, and lengthening equipment life.

Let Tide Water Associated help you select the best lubricant for your particular need. Write, wire or phone today to your nearest Tide Water Associated Office.

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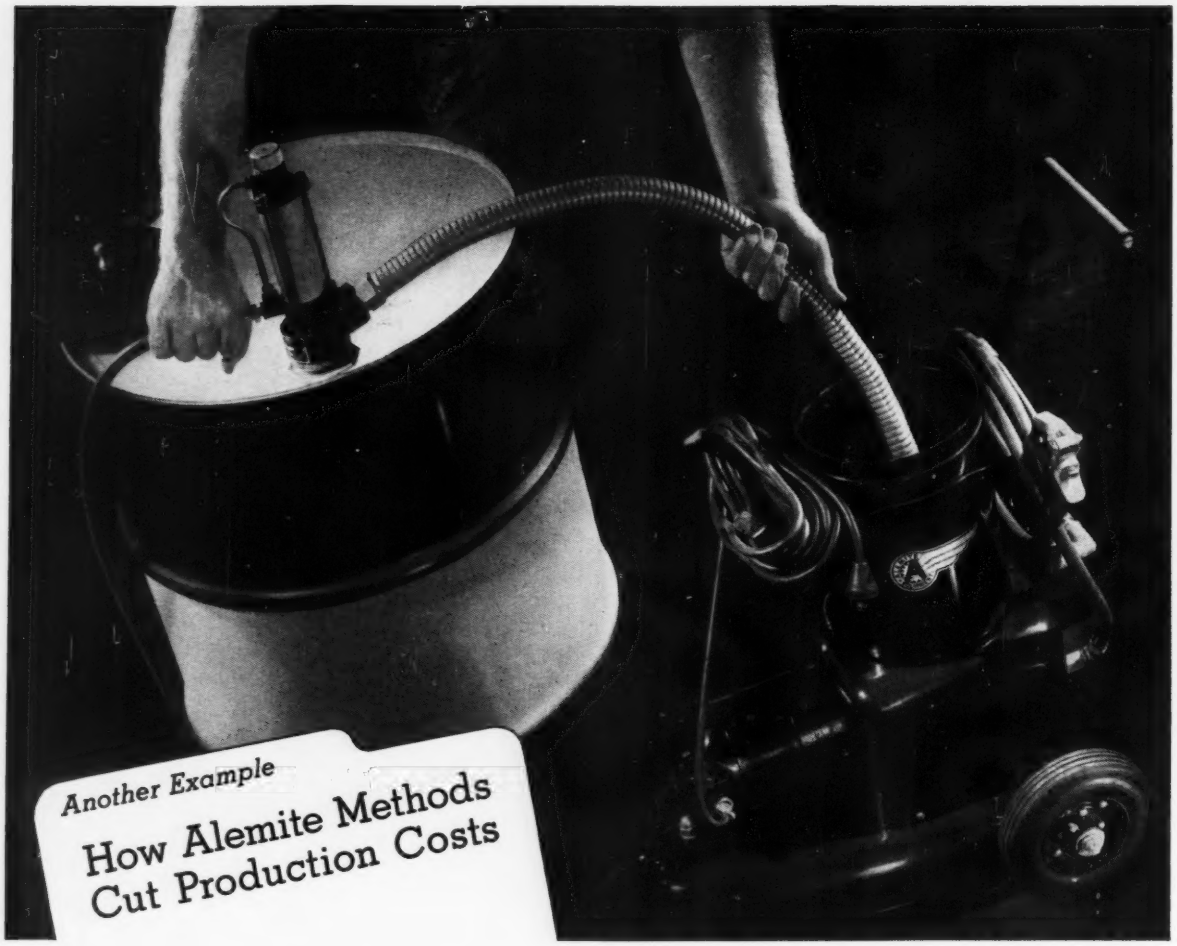
LUBRICATION — "ENGINEERED TO FIT THE JOB"



Ends Costly Bearing Failures

Adds Productive Time to Machines by Fast, Clean Mechanized Handling and Application of Lubricants

Your Lubrication Methods May Be More Antiquated Than You Suspect

A simple thing like transferring grease with a paddle may be boosting your maintenance costs—and that means lower productive capacity per dollar per machine. The Alemite Representative is a *specialist* in simplified, modern methods of handling and applying lubricants. A five minute conference with him may open your eyes to new cost-cutting ideas. Call your Alemite jobber or write to Alemite, 1847 Diversey Parkway, Chicago 14, Illinois.

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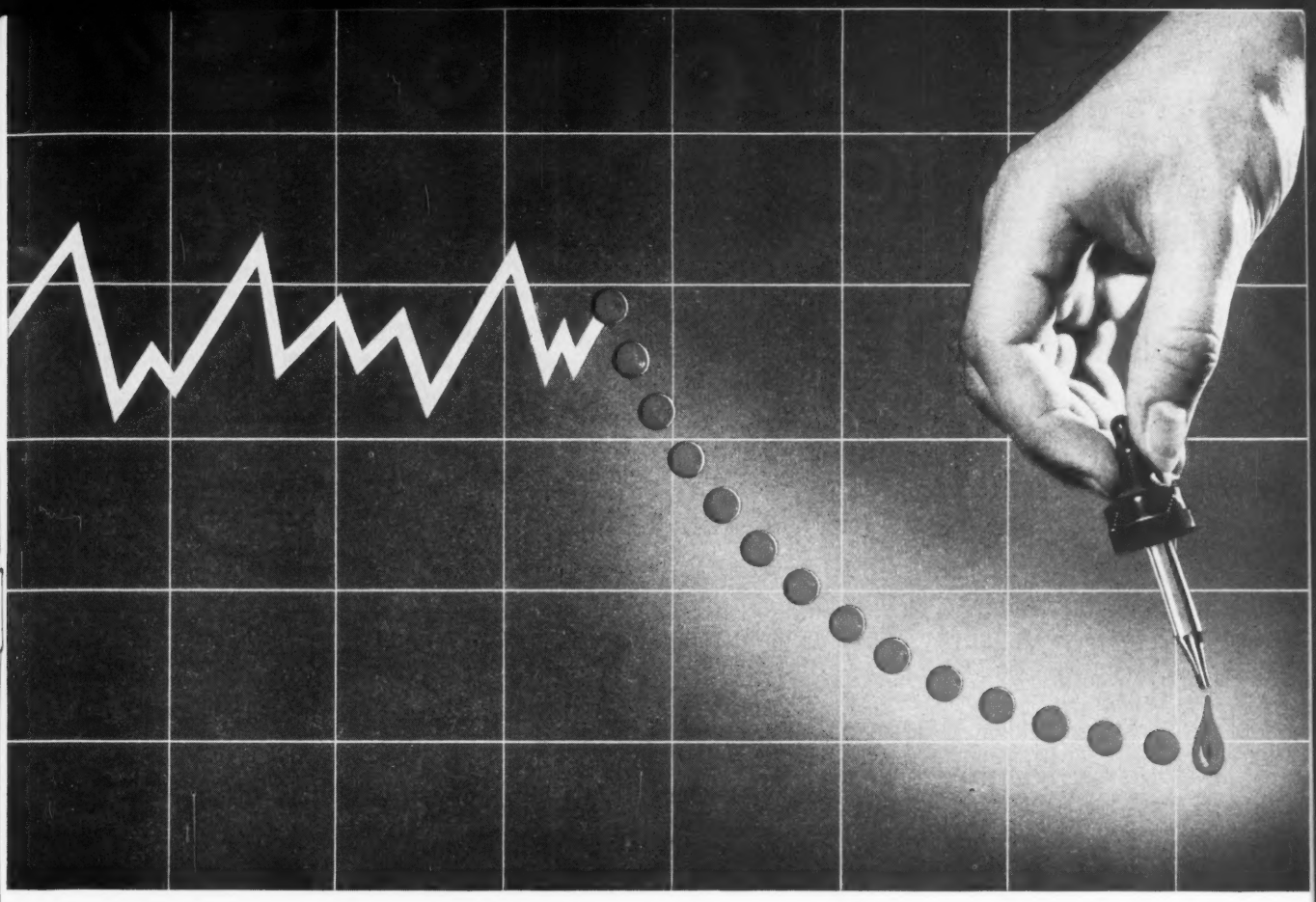
The Alemite Representative can show you case after case where actual practice or a time study analysis have proved that Alemite Methods eliminate wasteful and time-consuming handling of oils and greases . . . reduce shutdowns for repairs . . . time-outs for lubrication, add more productive time to machines. He can show you how to lubricate as many as 300 bearings from *one* central point without stopping the machines! Get the facts!

ALEMITE

Another Product of STEWART WARNER

MODERN LUBRICATION METHODS THAT CUT PRODUCTION COSTS



Want to see some sharp drops in metal working costs?

Just keep a sharp eye on production when you put Cimcool in your machines. It's a revolutionary new cutting fluid—a *chemical emulsion*—that cuts costs three important ways:

1. Cimcool prolongs tool life (and that means less down time) because of its *chemical lubricity.*

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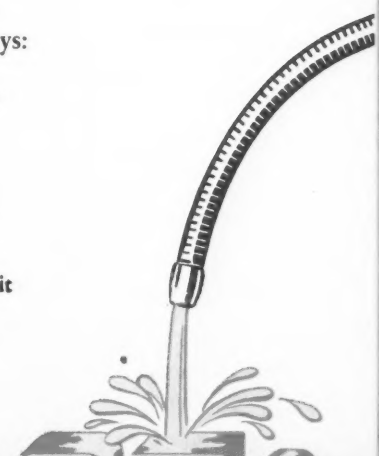

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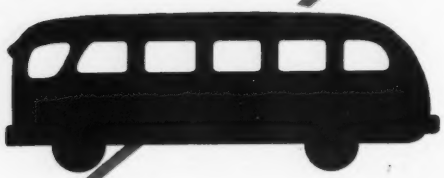

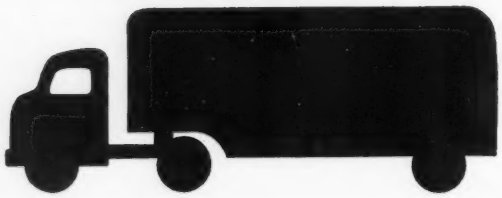

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THE EDITOR'S PAGE

YOUR editor recently received through the mail a little pamphlet, put out by the Small Business Economic Foundation. It related a familiar story, but told it so forcefully, that it seemed like a good move to obtain permission to paraphrase the high spots for this page. . . .

"Americans are constantly trying to sort themselves into separate bins, like vegetables in a grocery store. We tag our bins or groups of people with labels like "workers," "consumers," "business-men," "farmers," "stockholders," and so on. While it is true that all of these terms have useful meanings, the habit of constantly classifying people into one group or another is highly unrealistic, and can lead to all sorts of nonsense and confusion.

The reason is obvious. Nobody ever fits completely into any one classification. For instance, every worker is also a consumer. So are the people in all the other groups. Many workers and farmers are also stockholders. All of us share common rights, privileges and responsibilities as citizens, and most of us, as adults, have common cause as voters.

Now when we consider how many of these various groups each one of us actually belongs to, it is easy to see how impossible, unnatural and frequently just plain senseless it is to go around "labeling" people as belonging in this group or that group, without observing how many other groups they also belong in. And when you see or hear someone who constantly harps on this class-versus-class theme, watch out. Such a person is either awfully naive, grossly misinformed or grinding an axe.

This phony labelling of people and then selling them as "workers" on the idea that they are "against" their employers; or appealing to them as "liberals" to oppose a variety of other folk who are conveniently labeled "reactionaries,"—the whole process is a favorite trick of the Commies. It's the old divide-and-conquer technique and it fools too many people too much of the time.

Next to our role as citizens, the biggest common denominator we share in this country is that of being workers. It doesn't make much difference whether we work in overalls or a white collar. The point is that most of us have a job where we sell our energy and talents to create something of value, either as goods or as a service. For this we get an immediate return of money. But what we really get is a claim on the total supply of goods and service that all of us together create. The money just serves as a handy way of dividing up the results.

For instance, they say to you as a worker, "Demand more money for less work, then you'll get a bigger share of the goods and will have more time to enjoy them." It sounds good, but it slides right past the fact that unless you somehow also produce more goods, the extra money won't buy any more for you. Higher prices will set you back where you started.

You see, they neglected to say what would happen to you as a consumer while you were "gaining" as a worker. There has to be more goods to divide before more dollars will be of any help.

Here's another example of this kind of loose logic. They say, "Let's raise the taxes on employers (companies), then workers won't have to pay so much taxes." It sounds like a good idea—especially to politicians. But it's a bum joke in the long run. Here's why. Let's say the company you work for (the employer) pays an extra dollar to the government in taxes. To get the dollar it has 50 cents less to pay you the worker in wages; it has to charge you the consumer 45 cents more in the price of the goods it makes, and pay you the stockholder 5 cents less in dividends.

This is exactly how it works in real life. In 1946, for instance, the Government collected $8,600,000,000 in taxes from corporations, but the corporations collected the money from a great many individual people. The corporations "paid" the taxes in the sense that they turned it over to the tax collector. But to get the money to pay the taxes, the corporations had to add 8 6/10 billions to the selling price of their goods, or take some out of the funds used to pay wages or out of the money available to pay the people who own the corporations. They probably did all three things, with most of the tax money being added to the prices of goods sold, but the point is that the corporations were only the middlemen in the deal. Customers, workers, and stockholders (people) paid the taxes.

Most people are investors of some kind, even if their savings are small. For some strange reason, we understand our role as investors (or "stockholder" or "capitalist") in this system of ours much less clearly than we understand our roles as consumers or workers. This is very strange when we realize that it is the great amount of wealth which we as stockholders have "invested" in factories, tools, and equipment that makes our modern mass production system possible. There are about 14 million stockholders—all kinds of people—who "own" our corporations, and that doesn't count two million odd people who own their own small enterprises.

Part of the confusion arises from the endless clamor about "Wall Street" owning the capital and reaping most of the "profit" from our economy. This is just so much hogwash, as anyone can prove for himself with facts available in any public library. But it serves beautifully the objectives of people who want to divide us into false groups to quarrel among ourselves.

The actual owners of most of "Wall Street's" money are just plain every-day people who live all over the country, and who originally put their savings into bonds or an insurance policy or into a savings account. But none of this money just lays around in a bank vault. It gets put to work. It gets invested.

If you must identify investors as a group, you may be astonished to know that more than half of all the invested wealth in this country is owned or controlled by women. This fact always embarrasses the rabble rousers who like to harangue people about the "Ogres of Wall Street." This country long ago got too big and too complicated to be owned and run by any small group of speculating ogres in Wall Street or anywhere else.

But, and here's the thing to watch out for, almost any small group can "run the country"—and ruin it, too—if they can get hold of enough people's minds and confuse them into fighting among themselves as "workers" versus "owners," "consumers" versus "producers" or "this" group versus "that" group. As a free and equal citizen you can identify yourself with any cause or any program—and as many as them as you like. But you do the deciding. Don't let someone else herd you like sheep into blind and bleating memberships in his particular and exclusive group."

Lubrication Engineering Education

By DUDLEY D. FULLER *

Columbia University, New York

Dr. Dudley D. Fuller received his B.M.E. degree at City College of New York; M.S. degree at Columbia University. He taught at City College School of Technology, Dept. of Mechanical Engineering, until 1943. He came to Columbia University, Dept. of Mechanical Engineering, in 1943, advancing to rank of Assistant Professor in 1946. He has worked with the Gulf Research & Development Co. at Pittsburgh, Pennsylvania, and the Texas Co. Research Laboratory at Beacon, New York, as well as doing general consultant work on lubrication problems. Chairman, New York Section, A.S.L.E., two years. Chairman Educational Committee. Member Program Committee two years. Author of a series of articles on hydrostatic lubrication beginning in "Machine Design", June, 1947.

ONE of the primary motivations for the organization of this Society was to develop the means for making available sorely needed information on Lubrication. Lubricant suppliers and consumers faced with common problems, felt a very real need for some kind of mutually acceptable information to assist in the solution of those problems. From your own experience I am sure you can testify to the genuiness of that need. Whether it be in the one man shop or the very largest industrial plant or mill, whether it be the oiler or the maintenance superintendent, the questions have been, "What is the story on this?" "Where can I find out?" "What is the answer?" It is in supplying these answers or at least the background material essential to an understanding of the problems, that the ASLE is so directly concerned.

I should like to describe to you the various problems that confronted your Society, and in particular the Educational Committee in developing its Program and the decisions that were made before the present plan was formulated.

The first question naturally was "What form shall our educational activities take?" "Shall they be a series of lectures?" "Shall our approach be the usual one, the oral approach of the schools and universities?" Or shall our efforts be directed toward putting the material in printed form?

There are certain advantages to the method of direct verbal communication as you well know. In explaining something to a person by means of the spoken word, consciously or unconsciously you do adjust your explanation to fit his particular needs; his background; his experience. The same flexibility is present but to a lesser extent when addressing a group of people—providing, of course, the group is not too large. In a lecture or talk there is also the opportunity for the listener to raise questions. There are, however, disadvantages to the lecture method. Firstly, everyone must be assembled at one place and at one fixed time. This obviously is often impossible, especially for men such as yourselves. Secondly, the audience that can be reached is definitely limited. (I personally feel that a group of from 50 to 100 is about the largest size with which the lecturer can maintain effective contact. In the Mechanical Engineering Department at Columbia, for example, we have found that best results are obtained with classes of from 12 to 25 students.) Thirdly, in our list of disadvantages, the listener has no permanent record of what has been said. Note taking is possible, but not too convenient.

Consequently because of these difficulties we are convinced that the disadvantages of direct personal contact, for our purposes, far outweigh its advantages. Our first choice then is to use the more formal and impersonal presentation obtained through books and papers without benefit of the lecture process. It does seem fairly obvious after some recollection that the only practical way to reach a wide-spread and diversified group is through the medium of the printed page.

Now then—having decided that our information is to be written—how shall we write it? On the one hand it could be completely in the layman's language—the popular weekly magazine variety—or it could be written like a Ph. D. thesis. Again the first approach, the layman's approach, would certainly be understandable to a very wide group of people but the few technical writing tools that could be employed would make it extremely difficult to develop most of the fundamental concepts of lubrication. On the other hand with the mathematics and physics and chemistry comprehensible to someone with a Doctor's degree it would be comparatively simple to write about the subject, but then only a few people would be able to read and understand the ideas that were being set forth.

After considerable thought it is the consensus of opinion that we should aim for the middle of the road and attempt to reach the greatest number of people with material that will be sufficiently technical to allow adequate coverage of the subject.

The very minimum requirements for satisfactory ex-

* Member A. S. L. E. Paper presented at 3rd Annual Convention of A. S. L. E. April 19-21, 1948, Buffalo, N. Y.

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planation of lubrication phenomena seem to involve some algebra, some chemistry, and some physics. The middle of the road as we see it, is to use and build on the material that would be covered in a four-year high school course or its equivalent. In other words, it will be assumed that the reader will have an educational background equivalent to four years of high school.

Having decided that this information must be in printed form, and the level on which it should be written the next question that confronted the Educational Committee was this. "What phases of Lubrication shall we attempt to cover?"

This question has been given much thought. The initial proposal has been revised and adjusted several times benefiting from the combined experience and knowledge of many men in all branches of Lubrication activity until we have evolved a breakdown of the subject material into fourteen major categories. Included as an appendix to the printed verson of this paper will be a copy of the final proposal. With your permission I would like to mention some of these items very briefly. I would suggest that you refer to the appendix for the complete listing.

(1) Physical properties of lubrications. This would include a description of standard physical tests, test methods, commercial instruments that are used, significance of tests and sample data.

(2) Fluid Lubrication. Hydrostatic Lubrication. This is the type of lubrication employed so spectacularly on the Mount Palomar telescope and on syncro-converters, large ball mills and other heavy equipment. High pressure oil from some external source usually a pump is supplied to the bearing or load carrying device so that a fluid film is maintained independent of rotation of the component parts. The coefficient of friction con be made so low that in certain applications it actually approaches zero.

(3) Fluid Lubrication. Hydrodynamic Lubrication. Plane Bearings. The theory and practice of shoe-type thrust bearings including the standard commercial types.

(4) Fluid Lubrication. Hydrodynamic Lubrication. Journal Bearings. Theory and practice of sleeve-type journal bearings. Partial bearings and complete bearings. Steady loads, intermittent and pulsating loads. Energy balances.

(5) Fluid Lubrication. Imperfect Hydrodynamic Lubrication. These are the bearings that are fed with insufficient oil to build up a complete lubricant film. Examples are wick-fed and waste-packed bearings or they may be bearings subjected to extremely severe loads or slow speeds so that there is a tendency for the oil film to break down and cause partial metal-to-metal contact. Examples of this latter type would be piston-rings, gears, chains, ropes, etc.

(6) Bearing Components—Grooving, oil rings, discs, seals, gaskets, packing and glands. Setting up, inspection, maintenance.

(7) Lubricating Systems and Devices. Continuous and intermittent flow systems for oils and greases. Cups, fittings. Filtration, purification and reclamation of oils.

(8) Non-fluid Lubrication. Gear teeth, cutting tools, wire drawing dies, power screws, etc. Boundary friction. Oiliness additives. Use of E. P. lubricants and solid lubricants. Examples, test methods, interpretation of results.

(9) Dry Friction. Theories of dry friction according to Amonton, Coulomb, Tomlinson, Hardy, Bowden, etc. Effects of material, velocity of sliding, temperature, surface finish and contamination.

(10) Bearing Materials. Properties and use of metallic and non-metallic bearing materials. Standard practices in fabrication and use.

(11) Fluid Lubricants. Organic oils. Mineral oils. Synthetic oils. Standard chemical tests, test methods, commercial instruments, significance of tests and sample data.

(12) Non-fluid Lubricants. Mineral-oil-base greases. Additives in greases. Synthetic-oil-base-greases. Solid lubricants.

(13) Ball and Roller Bearings. Rolling friction. Theory and selection of ball, roller and needle bearings. Life expectancy, lubrication, installation, and maintenance.

(14) Organization. Organization of lubrication section of a plant. Importance of lubrication engineering to management. Personnel training and instruction.

It is expected that the material included in the fourteen topics, that have just been mentioned so very briefly, will cover most of the basic information essential to an understanding of the behavior of all types and varieties of lubricants, and related equipment and apparatus, under almost all conditions of operation.

The Educational Committee is well aware that certain lubrication practices are still what might be called controversial. The pros and cons still fly. If all points of view cannot be impartially presented by the ASLE, then it might be better to eliminate that particular subject altogether, until some kind of agreement can be reached between the interested groups. The ASLE will certainly not be biased in such instances or be so indiscret as to present a one-sided or misleading explanation.

This then is the program that is planned to reach the majority of those people who feel the need for information in any or all phases of Lubrication.

There is an additional group, a small one to be sure but none the less important and it is made up of young men who plan a career in Lubrication Engineering. I venture to say that not many of us in the field planned it that way. It probably just happened. Until quite recently there was no recognition of such a profession—but, of course, now there is. A young man building his career might well desire training and instruction that would compel recognition and secure for him the standing and respect that should be accorded the Lubrication Engineer.

The material needed by a Lubrication Engineer is quite specialized. Nevertheless we have gone back to the source of fundamental technical training, the Engineering Colleges to determine what could be done. This is what we have learned and it is what we might have expected. We found that educators were discussing courses and curricula very extensively and were in agreement on at least one point. And that point was—no specialization in the undergraduate years. Considerable pressure for example has been placed on Mechanical Engineering Departments of several Engineering Schools to institute undergraduate specialization in tool engineering, automotive engineering, and the like. Actually there is so much basic information that must be packed into the four-year engineering course that to replace any of it by certain specialized topics means that some fundamentals must necessarily be omitted. The result is that the student will not be completely rounded as far as his basic training is concerned. I will not labor the point for probably you are in agreement with it. College training then for the prospective Lubrication Engineer would be on the post graduate level. It could consist of a year of graduate work beyond that needed to attain a Bachelor's degree in Engineering.

This extra year's work would lead to a Master of Science Degree. The degree of Lubrication Engineer cannot be granted at this time as there are no Departments of Lubrication Engineering in any of the Engineering Schools.

The technical knowledge required for Lubrication Engineering is very diversified and cuts across convential divisions of engineering. A Lubrication Engineer has to feel at home in many fields of science and I am sure that can be verified from your own personal experience. He must be familiar with Chemistry, Chemical Engineering and Metallurgy. He must know some Physics and considerable Mechanical Engineering. He must be able to understand and use Mathematics and he should be familiar with Business Law, Labor relations, and the psychology of personnel handling and administration.

Two sample programs have been drawn up; the first for the student with a Bachelor's degree in Mechanical Engineering and the second for the student with a Bachelor's degree in Chemical Engineering. For the man with the Mechanical Engineering background we suggest about five credits, credit hours or points of Chemical Engineering consisting of courses covering fuels, lubricants, and combustion.

About 5 credits in Chemistry on organic Chemistry.

About 3 credits in Metallurgy on physical metallurgy.

About 3 credits in Physics on molecular physics.

About 13 credits in Mechanical Engineering with courses on machine design, lubrication, process machinery and experimental research.

About 2 credits in Industrial Engineering on industrial processes.

About 3 credits on engineering mathematics.

Lastly about 6 credits of subjects such as law, labor relations, psychology, and the like, making a total of approximately 40 credits.

Please understand that we are suggesting only general fields of study not specific courses. The actual courses to cover the chemistry and the metallurgy and the mechanical engineering and so forth will depend upon the available offerings of that particular institution under consideration.

A student with a background of Chemical Engineering will need a large proportion of Mechanical Engineering courses. Consequently we have suggested 23 credits in courses covering shop processes and methods of fabrication, process machinery, internal combustion engines, lubrication, and experimental research. Also:

About 3 credits in Chemical Engineering on petroleum.

About 3 credits in Metallurgy on physical metallurgy.

About 3 credits in Physics on molecular physics.

About 3 credits on engineering mathematics.

And lastly about 5 credits on such subjects as law, labor relations, psychology, and so forth, making a total of approximately 40 credits.

Columbia University has approved these programs. A detailed listing of the courses follows, which I will not read, but which will appear in the printed version of this paper.

Other engineering schools are now being contacted and we anticipate that their replies will be most favorable.

Example of curriculum designed to provide essential background and training for the Lubrication Engineer.

I. For a student with a Bachelor's degree in Mechanical Engineering:

Chem. Eng.	62	Fuels, Lubricants & Combustion	2
Chem. Eng.	268	Fuel Technology II Petroleum	3
Chemistry	43	Organic Chemistry	5
Metallurgy	149a	Physical Metallurgy	3
Physics	110	Molecular Physics	3
Mech. Eng.	232	Machine Design C	4
"	" 240	Eng. Mechanics B-2, Lubrication	3
"	" 246	Process Mach. B, Analysis	3
"	" 373	Mech. Eng. Experimental Research	3
Ind. Eng.	205	Industrial Processes	2
Eng. u	101	Problems of Engineering and their Mathematical treatment	3
Plus subjects as Law, Labor Relations, Psychology, etc.			6
			40

II. For a student with a Bachelor's degree in Chemical Engineering:

Mech. Eng.	142	Shop Processes A, Elements	4
"	" 143	Shop Processes B, Analysis	4
"	" 146	Process Machinery A, Principles	3
"	" 106	Internal Combustion A, Introduction	3
"	" 240	Eng. Mechanics B-2, Lubrication	3
"	" 246	Process Machinery B, Analysis	3
"	" 373	Mech. Eng. Experimental Research	3
Chem. Eng.	268	Fuel Technology II, Petroleum	3
Metallurgy	149a	Physical Metallurgy	3
Physics	110	Molecular Physics	3
Eng. u	101	Problems of Engineering and their Mathematical Treatment	3
Plus such subjects as Law, Labor Relations, Psychology, etc.			5
			40

It is recognized by your Society and by the Educational Committee that from time to time certain works of significant importance may be "discovered" as it were, which because of their great value should be given wider distribution than they might have otherwise enjoyed. It is the wish of the ASLE to do this and republish or translate or do whatever else may be necessary to make this material available to you. The first result of these endeavors is the book "Lubrication and Wear of Piston-Rings and Cylinders" by Poppinga which you will find on exhibition at this Convention. This volume is a summary of the extensive work done in Germany by the Ministry of Motor Transport prior to and during the war. I believe you will find it to be a most valuable addition to the literature in this field and that the information it contains will be of assistance in attempting to deal with wear problems that arise with internal-combustion engines. If it is in accord with your wishes your Society plans to make available further important publications concerned with Lubrication.

Finally although its publication is not a function of the Educational Committee we must recognize the great educational value of the Journal of the ASLE, "Lubrication Engineering" in bringing to us, periodically throughout the year the best of current technical literature and vital news of products and equipment. The Journal results from the combined efforts of its most able and faithful editor, Professor Burgess Jennings, our fine Secretary, Mr. William Leonard, and the Program Committee, headed so efficiently this past year by Dr. Henry Mahncke.

In conclusion allow me to summarize very briefly the various activities that have been described in this paper contributing to the overall Educational Program of the ASLE.

(1) A publication project in which the basic material of the field of Lubrication will be presented in fourteen individual booklets or monographs. These will be written in semi-technical language so as to effectively reach the widest possible group of interested people.

(2) Organization of a program for a graduate year of study in cooperation with many of the leading Engineering Schools. This graduate work will include subjects that are deemed essential for a Lubrication Engineer and which are presently found in a number of different Departments in a school. The degree arising from such work will of necessity be without particular affiliation with any one Department and will be the degree of Master of Science.

(3) Finally, various important works or publications, usually of specialized nature, will from time to time be translated or republished so as to make them more available. The publication and translation of Popinga is an example of this activity. One or two other works are currently under consideration. Your response to this initial offering and your recommendations for further publications will naturally be the determining factor in this phase of our Educational Program.

In the time that has been made available I have tried to give you an overall picture of what your Society has been planning and doing behind the scenes as it were, in the nature of Lubrication Engineering Education. Our plans and organization are now complete, and the wherewithal for greater activity on the part of the Educational Committee is slowly becoming available. As a consequence I venture to predict that in the months to come you will see much more evidence of the efforts of the Committee and of the Society itself to be of increasingly greater service to you.

APPENDIX

Outline of Topics
A.S.L.E. Educational Program

1. *Physical Properties of Lubricants*—Brief history of past practices in lubrication from ancient to modern times through periods where animal and vegetable fats and oils were used exclusively to discovery of petroleum and introduction of synthetic lubricants. Statement of the general problems of lubrication and reasons for division of material into subject headings of this series. Definition of basic terms and summary of notations used in the series. Viscosity. Fluid friction. Outline of modern molecular theory of viscosity. Viscosity units, physical and arbitrary. Conversions. Graphical representation of viscosity. Methods of measurement. Commercial instruments. A.S.T.M. Standards for conducting tests. Concentric cylinders. Conversion tables. Effect of temperature, pressure and rate of shear. Viscosity of blends. Viscosity index. Typical viscosity data. Specific gravity. Measurement of specific gravity. A.S.T.M. methods. National Bureau of Standards volume correction table. Cloud and pour points. A.S.T.M. methods for measurement. Significance of tests. Data. Examples. Flash and fire points. A.S.T.M. methods for measurement. Significance of tests. Data.

2. *Fluid Lubrication—I. Hydrostatic Lubrication*—Definition. Viscous flow through tubes and slots. Oil pad bearings. Oil lifts. Step bearings. Flat surfaces approaching each other when separated by a viscous fluid. Non-rotating journal in a bearing when subjected to an alternating load. Load-carrying capacity, oil flow, friction and energy losses. Examples.

3. *Fluid Lubrication — II. Hydrodynamic Lubrication, Plane Bearings*—History and theory. Pressure distribution on shoe or slipper. Effect of side leakage. Effect of shoe profile. Film thickness. Energy losses and temperature rise. Design charts. Air-lubricated model. Commercial types of thrust bearings. Sizes, construction details and examples. Data.

4. *Fluid Lubrication — III. Hydrodynamic Lubrication, Journal Bearings*—History and theory. Pressure distribution and load-carrying capacity. Effect of side leakage. Oil film thickness. General effect of location of source of lubricant supply. Partial bearings. Complete bearings. Steady loads. Intermittant and pulsating loads. Rotating loads. Friction losses. Bearing friction and journal friction. Design charts. Flow of oil and oil supply. Temperature rise. Heat balance. Prediction of operating conditions. Effect of bearing clearances. ZN/P as a parameter of performance. Length of actual load-carrying film in journal bearing. Limitations of theory in design of "heavy duty" journal bearings. Effect of pressure—viscosity relationship of lubricant on load-carrying capacity. Testing machines. Loading arrangement and measurement of friction. Film thickness measurements. Oil-flow and temperature measurements. Oil acting as coolant. Instability and oil-whip. Multi-pad journal bearings. Examples and illustrations of each of above items.

5. *Fluid Lubrication—IV. Imperfect Hydrodynamic Lubrication* — Wick-fed and waste-packed bearings. Oil flow through wicks and waste. Friction, temperature rise and heat dissipation. Electric motor, railroad journal-bearings, pivot bearings and collar bearings. Piston and piston-ring lubrication Gear lubrication. Chain and rope lubrication. Examples.

6. *Bearing Components*—Grooving for forced-feed oiling. Oil acting as coolant. Oil rings and discs, operating characteristics and delivery of oil. Grooving for gravity feeds. Oil seals, gaskets and packing. Glands. Commercial types. Setting up, inspection and maintenance. Problems arising from misalignment.

7. *Lubricating Systems and Devices*—Continuous flow circulating systems. Intermittent flow systems for oils and greases. Commercial types. Lubricating cups, fittings, etc. Ease of maintenance of lubricating system. Design of equipment with consideration of lubrication. Filtration of lubricants. Types of filters and their applications. Purifying and reclaiming of oils. Continuous and batch systems. Examples.

8. *Non-fluid Lubrication*—Examples of occurrence. Gear teeth. Cutting tools. Wire-drawing dies. Power screws. Roll-neck bearings. Bridge trunions, etc. Running-in process of most lubricated moving surfaces. Terms used to describe this type of friction such as "boundary," "greasy," etc. Explanation of phenomena. Effect of variables. Oiliness additives, organic and chemical, and their effects. Influence of pressure, velocity, temperature, surface finish and contaminants. E.P. Lubricants. Explanation of action. Solids as lubricants; graphite, molybdenum sulfide, etc. Examples. Wear and seizure. Testing methods and interpretation of results. Test machines.

9. *Dry Friction*—Theories of dry friction according to Amonton, Coulomb, Tomlinson, Hardy, Bowden, etc. Fretting corrosion. Effects of material, velocity of sliding and temperature. Variations in degree of "dryness." Effect of surface finish. Measurement of surface finish. Characteristics of principal finishing operations. Test machines. Data.

10. *Bearing Materials*—History of development of bearing materials. Properties and use of bearing materials such as babbitt, bronze, copper-lead, silver, cadmium silver, indium, aluminum alloy. Special metallic materials as cast iron, powdered metals, etc. Wood, rubber, plastics, leather, graphite, carbon, etc. Standard practices in fabrication and use.

11. *Fluid Lubricants*—Organic oils. Description and production of castor oil, tallow oil, olive oil, lard oil, etc. Mineral oils. Origins of petroleum. Types of crudes. Refining processes. Automotive oils. Industrial lubricants. Additives and their uses. Oilyness, anti-oxident, anti-corrosion, detergents, pour-point depressors, anti-foam, viscosity-index improvers, etc. Synthetic fluids. Silicones. "Ucon" lubricants. Tricresyl-phosphates. Production and properties. Specifications of lubricants. Standard chemical tests and their significance. Carbon residue, neutralization number, emulsification, saponification, oxidation, gumming, etc. A.S.T.M. methods. Sludging, corrosion and breakdown of lubricants. Examples.

12. *Non-fluid Lubricants*—Mineral oil-base greases. Manufacture. Basic types. Calcium, sodium, aluminum, lead-base greases, etc. Physical-chemical characteristics, and fields of application. Special purpose greases. Additives in greases. Extreme pressure lubricants. Examples. Test methods and interpretation of results. A.S.T.M. methods. Synthetic-oil-base greases. Production and fields of application. Solid lubricants. Graphite, Tungsten disulfide, Molybdenum disulfide, etc.

13. *Ball and Roller Bearings*—Rolling friction. Physical phenomena. Contact pressures. Fretting corrosion. Calculation of load-carrying capacity. Empirical selection of ball, roller and needle bearings. Life expectancy. Bearing types and uses. Lubrication and maintenance. Friction losses. Data. Examples.

14. *Organization*—Organization of lubrication section of a plant. Importance of lubrication engineering to management. Lubrication schedules. Storage, handling and purchasing. The economics of correct lubrication. Personal training and instruction. Standardization. Examples.

This extra year's work would lead to a Master of Science Degree. The degree of Lubrication Engineer cannot be granted at this time as there are no Departments of Lubrication Engineering in any of the Engineering Schools.

The technical knowledge required for Lubrication Engineering is very diversified and cuts across convential divisions of engineering. A Lubrication Engineer has to feel at home in many fields of science and I am sure that can be verified from your own personal experience. He must be familiar with Chemistry, Chemical Engineering and Metallurgy. He must know some Physics and considerable Mechanical Engineering. He must be able to understand and use Mathematics and he should be familiar with Business Law, Labor relations, and the psychology of personnel handling and administration.

Two sample programs have been drawn up; the first for the student with a Bachelor's degree in Mechanical Engineering and the second for the student with a Bachelor's degree in Chemical Engineering. For the man with the Mechanical Engineering background we suggest about five credits, credit hours or points of Chemical Engineering consisting of courses covering fuels, lubricants, and combustion.

About 5 credits in Chemistry on organic Chemistry.

About 3 credits in Metallurgy on physical metallurgy.

About 3 credits in Physics on molecular physics.

About 13 credits in Mechanical Engineering with courses on machine design, lubrication, process machinery and experimental research.

About 2 credits in Industrial Engineering on industrial processes.

About 3 credits on engineering mathematics.

Lastly about 6 credits of subjects such as law, labor relations, psychology, and the like, making a total of approximately 40 credits.

Please understand that we are suggesting only general fields of study not specific courses. The actual courses to cover the chemistry and the metallurgy and the mechanical engineering and so forth will depend upon the available offerings of that particular institution under consideration.

A student with a background of Chemical Engineering will need a large proportion of Mechanical Engineering courses. Consequently we have suggested 23 credits in courses covering shop processes and methods of fabrication, process machinery, internal combustion engines, lubrication, and experimental research. Also:

About 3 credits in Chemical Engineering on petroleum.

About 3 credits in Metallurgy on physical metallurgy.

About 3 credits in Physics on molecular physics.

About 3 credits on engineering mathematics.

And lastly about 5 credits on such subjects as law, labor relations, psychology, and so forth, making a total of approximately 40 credits.

Columbia University has approved these programs. A detailed listing of the courses follows, which I will not read, but which will appear in the printed version of this paper.

Other engineering schools are now being contacted and we anticipate that their replies will be most favorable.

Example of curriculum designed to provide essential background and training for the Lubrication Engineer.

I. For a student with a Bachelor's degree in Mechanical Engineering:

Chem. Eng.	62	Fuels, Lubricants & Combustion	2
Chem. Eng.	268	Fuel Technology II Petroleum	3
Chemistry	43	Organic Chemistry	5
Metallurgy	149a	Physical Metallurgy	3
Physics	110	Molecular Physics	3
Mech. Eng.	232	Machine Design C	4
"	" 240	Eng. Mechanics B-2, Lubrication	3
"	" 246	Process Mach. B, Analysis	3
"	" 373	Mech. Eng. Experimental Research	3
Ind. Eng.	205	Industrial Processes	2
Eng. u	101	Problems of Engineering and their Mathematical treatment	3
Plus subjects as Law, Labor Relations, Psychology, etc.			6
			40

II. For a student with a Bachelor's degree in Chemical Engineering:

Mech. Eng.	142	Shop Processes A, Elements	4
"	" 143	Shop Processes B, Analysis	4
"	" 146	Process Machinery A, Principles	3
"	" 106	Internal Combustion A, Introduction	3
"	" 240	Eng. Mechanics B-2, Lubrication	3
"	" 246	Process Machinery B, Analysis	3
"	" 373	Mech. Eng. Experimental Research	3
Chem. Eng.	268	Fuel Technology II, Petroleum	3
Metallurgy	149a	Physical Metallurgy	3
Physics	110	Molecular Physics	3
Eng. u	101	Problems of Engineering and their Mathematical Treatment	3
Plus such subjects as Law, Labor Relations, Psychology, etc.			5
			40

It is recognized by your Society and by the Educational Committee that from time to time certain works of significant importance may be "discovered" as it were, which because of their great value should be given wider distribution than they might have otherwise enjoyed. It is the wish of the ASLE to do this and republish or translate or do whatever else may be necessary to make this material available to you. The first result of these endeavors is the book "Lubrication and Wear of Piston-Rings and Cylinders" by Poppinga which you will find on exhibition at this Convention. This volume is a summary of the extensive work done in Germany by the Ministry of Motor Transport prior to and during the war. I believe you will find it to be a most valuable addition to the literature in this field and that the information it contains will be of assistance in attempting to deal with wear problems that arise with internal-combustion engines. If it is in accord with your wishes your Society plans to make available further important publications concerned with Lubrication.

Finally although its publication is not a function of the Educational Committee we must recognize the great educational value of the Journal of the ASLE, "Lubrication Engineering" in bringing to us, periodically throughout the year the best of current technical literature and vital news of products and equipment. The Journal results from the combined efforts of its most able and faithful editor, Professor Burgess Jennings, our fine Secretary, Mr. William Leonard, and the Program Committee, headed so efficiently this past year by Dr. Henry Mahncke.

In conclusion allow me to summarize very briefly the various activities that have been described in this paper contributing to the overall Educational Program of the ASLE.

(1) A publication project in which the basic material of the field of Lubrication will be presented in fourteen individual booklets or monographs. These will be written in semi-technical language so as to effectively reach the widest possible group of interested people.

(2) Organization of a program for a graduate year of study in cooperation with many of the leading Engineering Schools. This graduate work will include subjects that are deemed essential for a Lubrication Engineer and which are presently found in a number of different Departments in a school. The degree arising from such work will of necessity be without particular affiliation with any one Department and will be the degree of Master of Science.

(3) Finally, various important works or publications, usually of specialized nature, will from time to time be translated or republished so as to make them more available. The publication and translation of Popinga is an example of this activity. One or two other works are currently under consideration. Your response to this initial offering and your recommendations for further publications will naturally be the determining factor in this phase of our Educational Program.

In the time that has been made available I have tried to give you an overall picture of what your Society has been planning and doing behind the scenes as it were, in the nature of Lubrication Engineering Education. Our plans and organization are now complete, and the wherewithal for greater activity on the part of the Educational Committee is slowly becoming available. As a consequence I venture to predict that in the months to come you will see much more evidence of the efforts of the Committee and of the Society itself to be of increasingly greater service to you.

APPENDIX

Outline of Topics
A.S.L.E. Educational Program

1. *Physical Properties of Lubricants*—Brief history of past practices in lubrication from ancient to modern times through periods where animal and vegetable fats and oils were used exclusively to discovery of petroleum and introduction of synthetic lubricants. Statement of the general problems of lubrication and reasons for division of material into subject headings of this series. Definition of basic terms and summary of notations used in the series. Viscosity. Fluid friction. Outline of modern molecular theory of viscosity. Viscosity units, physical and arbitrary. Conversions. Graphical representation of viscosity. Methods of measurement. Commercial instruments. A.S.T.M. Standards for conducting tests. Concentric cylinders. Conversion tables. Effect of temperature, pressure and rate of shear. Viscosity of blends. Viscosity index. Typical viscosity data. Specific gravity. Measurement of specific gravity. A.S.T.M. methods. National Bureau of Standards volume correction table. Cloud and pour points. A.S.T.M. methods for measurement. Significance of tests. Data. Examples. Flash and fire points. A.S.T.M. methods for measurement. Significance of tests. Data.

2. *Fluid Lubrication—I. Hydrostatic Lubrication*—Definition. Viscous flow through tubes and slots. Oil pad bearings. Oil lifts. Step bearings. Flat surfaces approaching each other when separated by a viscous fluid. Non-rotating journal in a bearing when subjected to an alternating load. Load-carrying capacity, oil flow, friction and energy losses. Examples.

3. *Fluid Lubrication — II. Hydrodynamic Lubrication, Plane Bearings*—History and theory. Pressure distribution on shoe or slipper. Effect of side leakage. Effect of shoe profile. Film thickness. Energy losses and temperature rise. Design charts. Air-lubricated model. Commercial types of thrust bearings. Sizes, construction details and examples. Data.

4. *Fluid Lubrication — III. Hydrodynamic Lubrication, Journal Bearings*—History and theory. Pressure distribution and load-carrying capacity. Effect of side leakage. Oil film thickness. General effect of location of source of lubricant supply. Partial bearings. Complete bearings. Steady loads. Intermittant and pulsating loads. Rotating loads. Friction losses. Bearing friction and journal friction. Design charts. Flow of oil and oil supply. Temperature rise. Heat balance. Prediction of operating conditions. Effect of bearing clearances. ZN/P as a parameter of performance. Length of actual load-carrying film in journal bearing. Limitations of theory in design of "heavy duty" journal bearings. Effect of pressure—viscosity relationship of lubricant on load-carrying capacity. Testing machines. Loading arrangement and measurement of friction. Film thickness measurements. Oil-flow and temperature measurements. Oil acting as coolant. Instability and oil-whip. Multi-pad journal bearings. Examples and illustrations of each of above items.

5. *Fluid Lubrication—IV. Imperfect Hydrodynamic Lubrication* — Wick-fed and waste-packed bearings. Oil flow through wicks and waste. Friction, temperature rise and heat dissipation. Electric motor, railroad journal-bearings, pivot bearings and collar bearings. Piston and piston-ring lubrication Gear lubrication. Chain and rope lubrication. Examples.

6. *Bearing Components*—Grooving for forced-feed oiling. Oil acting as coolant. Oil rings and discs, operating characteristics and delivery of oil. Grooving for gravity feeds. Oil seals, gaskets and packing. Glands. Commercial types. Setting up, inspection and maintenance. Problems arising from misalignment.

7. *Lubricating Systems and Devices*—Continuous flow circulating systems. Intermittent flow systems for oils and greases. Commercial types. Lubricating cups, fittings, etc. Ease of maintenance of lubricating system. Design of equipment with consideration of lubrication. Filtration of lubricants. Types of filters and their applications. Purifying and reclaiming of oils. Continuous and batch systems. Examples.

8. *Non-fluid Lubrication*—Examples of occurrence. Gear teeth. Cutting tools. Wire-drawing dies. Power screws. Roll-neck bearings. Bridge trunions, etc. Running-in process of most lubricated moving surfaces. Terms used to describe this type of friction such as "boundary," "greasy," etc. Explanation of phenomena. Effect of variables. Oiliness additives, organic and chemical, and their effects. Influence of pressure, velocity, temperature, surface finish and contaminants. E.P. Lubricants. Explanation of action. Solids as lubricants; graphite, molybdenum sulfide, etc. Examples. Wear and seizure. Testing methods and interpretation of results. Test machines.

9. *Dry Friction*—Theories of dry friction according to Amonton, Coulomb, Tomlinson, Hardy, Bowden, etc. Fretting corrosion. Effects of material, velocity of sliding and temperature. Variations in degree of "dryness." Effect of surface finish. Measurement of surface finish. Characteristics of principal finishing operations. Test machines. Data.

10. *Bearing Materials*—History of development of bearing materials. Properties and use of bearing materials such as babbitt, bronze, copper-lead, silver, cadmium silver, indium, aluminum alloy. Special metallic materials as cast iron, powdered metals, etc. Wood, rubber, plastics, leather, graphite, carbon, etc. Standard practices in fabrication and use.

11. *Fluid Lubricants*—Organic oils. Description and production of castor oil, tallow oil, olive oil, lard oil, etc. Mineral oils. Origins of petroleum. Types of crudes. Refining processes. Automotive oils. Industrial lubricants. Additives and their uses. Oilyness, anti-oxident, anti-corrosion, detergents, pour-point depressors, anti-foam, viscosity-index improvers, etc. Synthetic fluids. Silicones. "Ucon" lubricants. Tricresyl-phosphates. Production and properties. Specifications of lubricants. Standard chemical tests and their significance. Carbon residue, neutralization number, emulsification, saponification, oxidation, gumming, etc. A.S.T.M. methods. Sludging, corrosion and breakdown of lubricants. Examples.

12. *Non-fluid Lubricants*—Mineral oil-base greases. Manufacture. Basic types. Calcium, sodium, aluminum, lead-base greases, etc. Physical-chemical characteristics, and fields of application. Special purpose greases. Additives in greases. Extreme pressure lubricants. Examples. Test methods and interpretation of results. A.S.T.M. methods. Synthetic-oil-base greases. Production and fields of application. Solid lubricants. Graphite, Tungsten disulfide, Molybdenum disulfide, etc.

13. *Ball and Roller Bearings*—Rolling friction. Physical phenomena. Contact pressures. Fretting corrosion. Calculation of load-carrying capacity. Empirical selection of ball, roller and needle bearings. Life expectancy. Bearing types and uses. Lubrication and maintenance. Friction losses. Data. Examples.

14. *Organization*—Organization of lubrication section of a plant. Importance of lubrication engineering to management. Lubrication schedules. Storage, handling and purchasing. The economics of correct lubrication. Personal training and instruction. Standardization. Examples.

Filtration of Insulating Oil Through Adsorbent Materials

By E. M. KIPP *

Chief, Lubricants Division, Aluminum Research Laboratories,
Aluminum Company of America, New Kensington, Pa.

Dr. E. M. Kipp received his elementary school education from his father and preliminary college work at a Portuguese Military High School. Later, the B. S. degree was awarded from Iowa Wesleyan College, the A. M. Degree from Boston University, and his Ph. D. degree from Pennsylvania State College. Since 1939, he has been employed by the Aluminum Research Laboratories of the Aluminum Company of America, New Kensington, Pennsylvania, where he is now Chief of the Lubricants Division. A major share of his duties have been associated with specialized problems of metal process lubrication, power system oils, diesel engine lubrication, etc. Dr. Kipp is past President of the American Society of Lubrication Engineers, and at present a Director in the Society; Chairman of the Projects and Publicity Committee, and is a member of many clubs and societies.

Introduction

THE Aluminum Company of America has employed Activated Alumina for many years as an adsorbent for the maintenance of power system oils. This maintenance procedure is now standard throughout the Company.

Nevertheless, the efficacy of this type of maintenance remains a controversial subject among power system engineers. Opinions expressed to the writer, as well as oral discussions presented at various technical meetings, indicate the opinion that teatment of these oils with adsorbents may adversely affect their useful life. It is thought by some that filtration of an insulating o'l through activated absorbents results in the removal by these adsorbents of any naturally occurring inhibitors or anti-oxidants which may be present in the oils, resulting in lowered resistance to oxidation and hence a greater tendency for these oils to form sludge, varnish, corrosive acids, etc.

The Aluminum Research Laboratories are continuing their search for the most effective procedures for the maintenance of power system oils. This problem is a complex one. For example, the available data indicate that mesh size, ratio of adsorbent to total volume of oil, rate of flow of oil through adsorbent, temperature of oil and adsorbent, operating conditions of the oil, as well as other factors must be considered. This paper is not intended as a report of the broad subject; its only purpose is to show that filtration of a typical insulating oil through adsorbent materials can be carried out with beneficial results insofar as the useful life of the oil is concerned.

* Member A.S.L.E. Paper presented at Third Annual Convention of A.S.L.E., April 19-21, 1948, Buffalo, N. Y.

Experimental Procedure

A diagram of the apparatus is given in Fig. 1. The apparatus comprises a modified ASTM turbine oil oxidation cell from which oil is by-passed through an adsorption tower filled with the particular adsorbent under investigation. The filtered oil is then returned to the oxidation cell. An Eastern Midget Centrifugal pump is used to circulate the oil.

The adsorbents employed include Activated Aluminas as well as other types of adsorbents. These materials are identified in the tables and graphs only as adsorbent "A" or "B" or "C," etc. All of the adsorbents were from 4 to 20 mesh in particle size.

The oil employed is a commercial, widely-used insulating oil without added inhibitor or other addition agents.

The procedure employed in this investigation is such that the observed rates of oxidation of the oil respond sharply to differences in types of adsorbent, even though accelerated rates of oxidation are employed.

Approximately 650-700 ml. of oil are placed in the apparatus. The adsorbent tower is filled with 200 grams of the adsorbent under investigation. The oxidation cell is placed in an oil bath, the temperature of which is adjusted so as to maintain the oil in the oxidation cell at a temperature of 120°C±0.5°. The temperature of the oil passing through the adsorbent tower, which is placed on the floor near the oil bath, is not controlled externally but is governed by the rate of flow of the oil trough the adsorbent tower. The temperature of the oil passing through the adsorbent tower was found to remain quite consistently in the 110-120°C range.

A coil made from a 300 cm. length of B and S #16 gauge copper wire, thoroughly cleaned of oxide and grease according to prescribed ASTM procedure, is employed as a catalyst. Oxygen is introduced into the oil at a rate of 3 liters per hour.

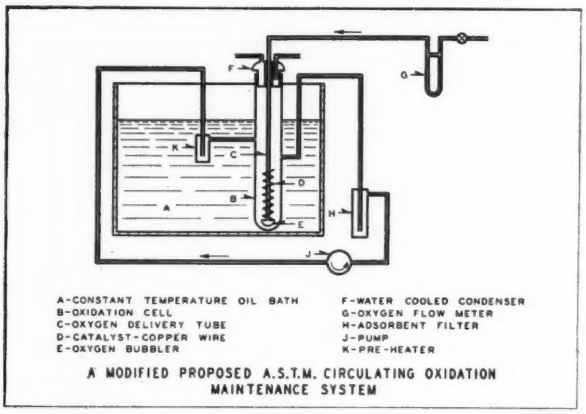
In general, sampling of the oil undergoing oxidation is made at 80-hour intervals except when the rates of oxidation are such as to indicate the need for more frequent testing. In sampling the oil, 50 ml. are removed from the oxidation cell by pipette and a corresponding volume of new oil added after the sampling. This is done in order to maintain the volume of oil under oxidation at a constant value.

The interfacial tension and acid number values of the oil are measured. These analyses were carried out in accordance with standard ASTM procedures. The usual correction factors are not applied inasmuch as we are concerned only with relative changes in interfacial tension values rather than in the absolute values.

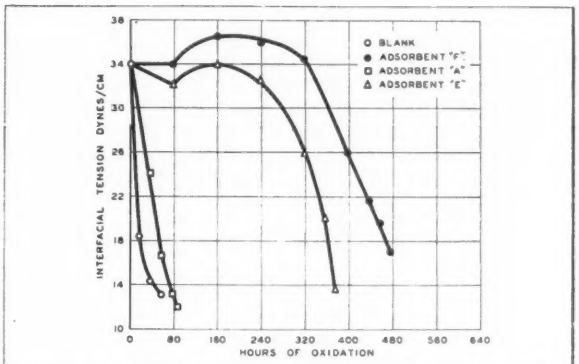
Experimental Results

Experimental data are presented in the form of graphs as shown in Figs. 2 to 7. The change in interfacial tension values with time is plotted in Figs. 2 to 4, while the corresponding change in acid value is shown in Figs. 5 to 7.

A tabulated summary of the relative effectiveness of the various adsorbents in preventing deterioration of the oil is given in Table I. A quick inspection of the data in that table will provide a reasonable good picture of the effects of continuous by-pass filtration of the oil through these various adsorbents upon the characteristics of the oil.

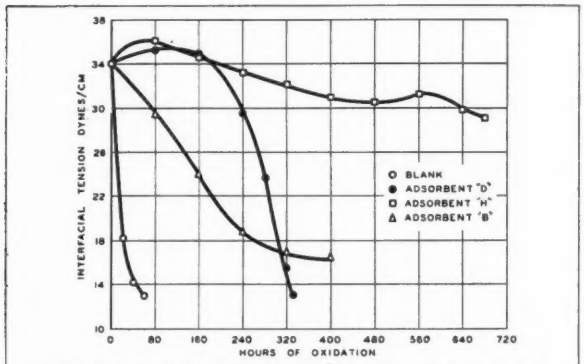


A MODIFIED PROPOSED A.S.T.M. CIRCULATING OXIDATION MAINTENANCE SYSTEM



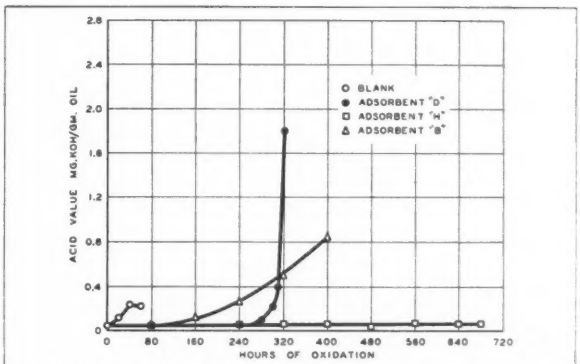
EFFECT OF VARIOUS MAINTENANCE MEDIA ON OXIDATION RATE OF NEW INSULATING OIL

Fig. 4



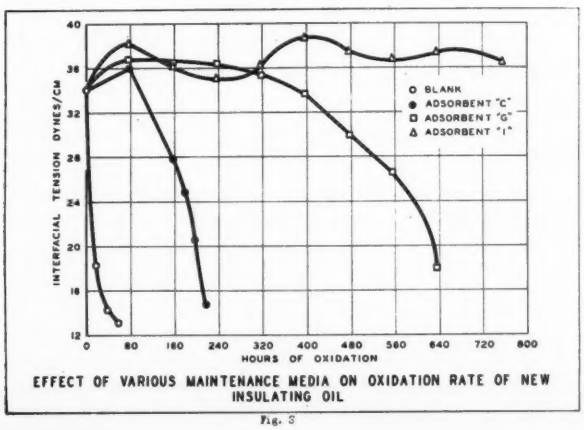
EFFECT OF VARIOUS MAINTENANCE MEDIA ON OXIDATION RATE OF NEW INSULATING OIL

Fig. 2



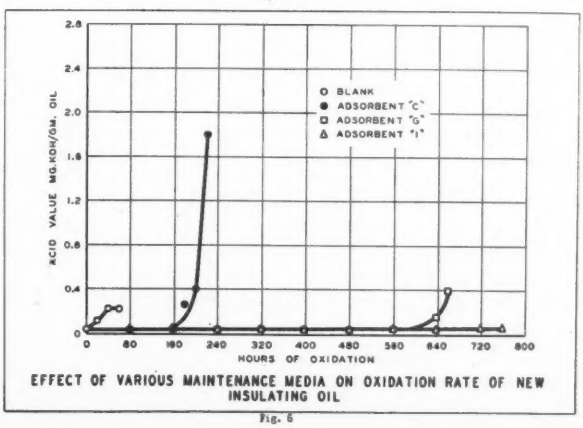
EFFECT OF VARIOUS MAINTENANCE MEDIA ON OXIDATION RATE OF NEW INSULATING OIL

Fig. 5



EFFECT OF VARIOUS MAINTENANCE MEDIA ON OXIDATION RATE OF NEW INSULATING OIL

Fig. 3



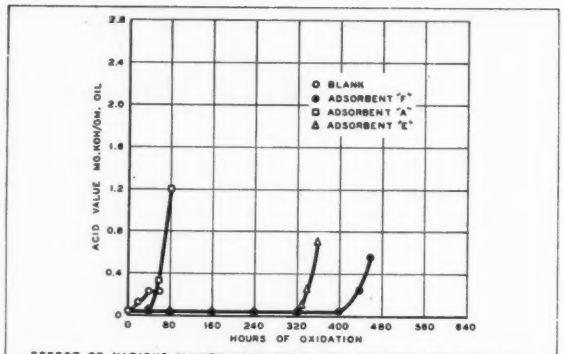
EFFECT OF VARIOUS MAINTENANCE MEDIA ON OXIDATION RATE OF NEW INSULATING OIL

Fig. 6

Discussion

The temperature of the oil during oxidation is known to have a definite effect upon the performance characteristics of the particular adsorbent media. For example, we have found that at temperatures exceeding 120°C, some of the adsorbents will cease to exert a beneficial effect upon the life of the oil even to the extent of accelerating the deterioration of the oil. Thus the preliminary data suggest that for any particular adsorbent material, there may be an optimum range of temperatures under which that particular adsorbent will yield the best results.

Another factor which has not as yet been thoroughly investigated is that of the rate of flow of the oil through the adsorbent media. Under the conditions of experiments covered in this report, the flow of oil through the adsorbent media was very rapid, being of such magnitude as to result in the complete filtration of the entire volume of oil through the adsorbent several times per hour. Data are not available at the present time



EFFECT OF VARIOUS MAINTENANCE MEDIA ON OXIDATION RATE OF NEW INSULATING OIL

Fig. 7

TABLE 1

COMPARISON OF VARIOUS ADSORBENTS AS MAINTENANCE MEDIA DURING VIGOROUS OIL OXIDATION

Adsorbents	Time of Oxidation to Interfacial Tension Value of 30 dynes/cm	Time of Oxidation to Interfacial Tension Value of 18 dynes/cm	Time of Oxidation to Acid Value of 0.2	Remarks
None	4 hrs.	20 hrs.	36 hrs.	Sludge formed after 20 hours
"A" (14-28 mesh)	16 hrs.	56 hrs.	56 hrs.	Sludging point not determined
"B" (14-28 mesh)	76 hrs.	260 hrs.	216 hrs.	Sludge formed after 288 hours
"C" (4-20 mesh)	140 hrs.	210 hrs.	184 hrs.	No sludge formed
"D" (4-20 mesh)	236 hrs.	304 hrs.	300 hrs.	No sludge formed
"E" (14-18 mesh)	280 hrs.	372 hrs.	336 hrs.	No sludge formed
"F" (4-20 mesh)	360 hrs.	472 hrs.	456 hrs.	No sludge formed
"G" (4-20 mesh)	476 hrs.	640 hrs.	644 hrs.	No sludge formed
"H" (10-20 mesh)	640 hrs.	Greater than 680 hrs. (Run Terminated)	Greater than 680 hrs. (Run Terminated)	No sludge formed
"I" (14-18 mesh)	Greater than 760 hrs. (Run Terminated)	Greater than 760 hrs. (Run Terminated)	Greater than 760 hrs. (Run Terminated)	No sludge formed

regarding the effect of other flow rates upon the life of the oil undergoing oxidation.

Although the effect of particle size of adsorbent has not yet been investigated, it is probable that this factor will also have a direct bearing upon the effectiveness of an adsorbent as a maintenance medium for the oil. There are, in addition to these variables, others which will occur to any one familiar with this type of problem. Nevertheless, the adsorbents employed in this investigation are representative of commercially available adsorbents as presently marketed for oil maintenance and reclamation purposes, and have not been treated in any way prior to their use in these investigations.

In spite of the limitations governing these investngations, it is felt that the data obtained are of general interest, indicating as they do that continuous filtration of an oil through a suitable activated type adsorbent can greatly extend the useful life of the oil.

Conclusions

Under the experimental conditions employed, the following conclusions seem warranted:

1. Continuous by-pass filtration of oil through an activated adsorbent will delay destructive oxidation of the oil.

2. Different adsorbents exhibit marked differences in their ability to prolong the life of an oil.

3. The use of certain adsorbents permits oxidation of the oil to proceed to an advanced stage, as measured by the interfacial tension value, while at the same time completely inhibiting formation of sludge. This suggests that the sludging point of an oil may be greatly delayed through the proper use of by-pass filtration through an absorbent.

Mechanism of Action of Bearing Corrosion Inhibitors in Crankcase Lubricants

By J. D. GUTTENPLAN AND C. F. PRUTTON *

Lubrizol Corp. and Case Institute of Technology

Jack D. Guttenplan graduated from Case Institute of Technology in April, 1945, with a B.S. degree in Chemical Engineering. He served 18 months overseas as an Ensign in the U. S. Navy, returned to Case Institute of Technology in October, 1946 and was appointed a Lubrizol Fellow. Received M.S. in Chemical Engineering in January, 1948. Presently employed as a research associate at Case Institute of Technology, investigating the effects of gasoline additives for the Lubrizol Corp.

Carl F. Prutton, Chemical Research Executive, Cleveland, Ohio. He taught Chemistry in the Case School of Applied Science and became Professor of Chemistry and Chemical Engineering in 1936. He has done much work in development and has acted as Consultant on the War Production Board, Lubrizol Corporation, Dow Chemical Company, and many others. He is the author of numerous scientific papers in the fields of physical chemistry, lubricants, corrosion and chemical engineering.

COPPER-LEAD connecting rod bearings have been in use for many years in heavy duty internal combustion engine service. Occasional service failures have shown the sensitivity of this type of bearing metal alloy to corrosive attack by the oxidation products of crankcase lubricants or by similar compounds produced by partial oxidation of the engine fuel. To minimize such corrosive attack, present-day crankcase lubricants contain corrosion inhibitors which give excellent performance. Among the satisfactory inhibitors in use are several distinctly different types of organic chemical compounds. As an aid in the development of new and improved corrosion inhibitors, this study on the mechanism of action of corrosion inhibitors was initiated.

The preliminary stage in the corrosion failure of a copper-lead bearing has been clearly shown to be due to a selective removal of the lead phase from the bearing surface [11] (Fig. 1).

Previous investigations in this laboratory [10], [11], [12], [13] on the corrosion of pure lead in hydrocarbon solutions have shown:

1. Corrosion of lead in hydrocarbon media requires both an *acidic material,* such as a carboxylic acid, and an *oxidizing agent.*

General Corrosion Reaction:

$$Pb + RO_2H \rightarrow PbO + ROH$$
$$PbO + 1.5\ H\ (R') \rightarrow Pb(OH)_{.5}(R')_{1.5} + .5\ H_2O$$

2. Oxidizing agents, which have been found effective in this corrosion reaction, include:

Oxygen	Organic nitrogen compounds, where nitrogen possesses a valence above —3.
Quinone	
Peroxides (organic)	
Nitro compounds	Diacetyl.

3. At high concentrations of oxidizing agent, corrosion rates vary with the nature and concentration of acidic agent present. As the concentration of low molecular weight fatty acids is increased, a rapid increase in corrosion rate is obtained and then a decrease as their concentration is still further increased. High molecular weight fatty acids give low corrosion rates until a certain critical concentration is reached, then the rate increases to a high almost constant value at higher acid concentrations.

4. Addition of a minute amount of low molecular weight acid greatly reduces the critical concentration for the higher acids. This catalytic effect is clearly shown in Fig. 2.

Corrosion of lead is therefore a complex function of acid and oxidizing agent concentration, of temperature, and of combinations of acids. Thus one cannot arbitrarily establish an acid concentration or neutralization number of a hydrocarbon oil below which corrosion rates will be negligible.

5. Further work [11] has established that the corrosion of the lead phase from a copper-lead bearing follows the same rules as the corrosion of pure lead.

Corrosion of the lead phase from a copper-lead

* Consultant, Lubrizol Corporation. Paper presented at Third Annual Convention of A.S.L.E., April 19-21, 1948, Buffalo, N. Y.

bearing metal in service undoubtedly results from the joint action of carboxylic acids and of oxidizing agents produced by the partial oxidation of lubricant or fuel hydrocarbons. Recently, Zuidema [15], George, Rideal and Robertson [9], Farmer [1, 2, 3, 4, 5, 6], and others have greatly clarified the mechanism of hydrocarbon oxidation. From their work, it appears that hydroperoxides are a primary product in hydrocarbon oxidation. It is therefore reasonable to assume that hydroperoxides are one of the principal oxidizing agents contributing to bearing corrosion.

However, there are certain facts difficult to reconcile with this position. Bearings corrode rapidly at high service temperatures, say 120°C and above, yet we have been unable to find a hydroperoxide which is fairly stable at these elevated temperatures. This does not prove that more stable hydroperoxides are not formed, and it is possible that a relatively unstable hydroperoxide may perform its action in corrosion before it decomposes. Certain other oxidizing agents are stable in oil at high temperatures and are highly effective in the corrosion of lead. These substances include diacetyl, quinone and organic nitro compounds. As far as we are aware the existence of these materials in used crankcase oils has not been studied, with the exception of some inconclusive work on nitro componds. The presence of peroxides, however, has been demonstrated, and we shall assume that the oxidizing agents active in bearing corrosion are peroxides and oxygen.

Possible Modes of Corrosion Inhibitor Action

From a consideration of the factors affecting the rate of corrosion of pure lead, combined with our present knowledge on oil oxidation, it is possible to postulate several mechanisms, by which a corrosion inhibitor may function.

First, the inhibitor may reduce corrosion by catalytic influence in the course of the oxidation process; for example:

(a) Directly, as an oxidation retarder,
(b) By altering the nature of the oxidation products to produce substances of lower corrosive action.
(c) By "deactivating" metal surfaces or metal compounds which normally act as oxidation promoters.

Second, oxidizing agents in the oil may be chemically or catalytically destroyed by the inhibitor.

Third, the inhibitor may form a surface film on the bearing metal which

(a) May catalytically destroy peroxides,
(b) May chemically reduce oxidizing agents,
(c) May form an impervious protective film, preventing the corroding agents from contacting the lead crystals in the bearing surface.

In this paper, studies on the second and third of the above modes of action will be presented, along with partial data on the effect of corrosion inhibitors in oil oxidation.

Experimental

1. *Corrosion Inhibitors Studied.*

Five commercial bearing corrosion inhibitors of different types were selected for this study. Although the effectiveness in service of these inhibitors varies somewhat depending upon operating conditions, all have given adequately good performance in service to warrant their inclusion in this work. In Table 1 are given the chemical composition and general nature of these inhibitors, with the concentrations in which they are normally employed in a crankcase lubricant.

2. *Oxidizing Agent Used.*

Tertiary butylhydroperoxide (60 per cent) was obtained from the Union Bay State Chemical Company and employed without purification. This peroxide contains t-butyl alcohol as the main inactive ingredient and was found to be fairly stable in oil solution at 100°C. This material was identical with that employed in our previous work on pure lead corrosion.

3. *Acidic Agent Employed.*

Purified lauric acid [13] was selected as the acidic material for this investigaiton. Lauric acid, obtained from Eimer and Amend Chemical Company (NO. A-163), was recrystallized from ethyl alcohol and the crystals dried in vacuum. In all test solutions the starting concentration of lauric acid was one-tenth normal. This concentration is well above the critical concentration for lauric acid (Fig. 2) and provides sufficient reserve acidity to maintain the concentration of acid above the critical value during the duration of all experimental tests.

4. *Bearing Metal Samples.*

Specially cast cylinders of 70-30 No. F-14 copper-lead bearing metal were obtained through the courtesy of the Cleveland Graphite Bronze Company. These cylinders were turned down to approximate dimensions and given a final standard surface grinding to dimension. The final cylinders were 1.125 inches long and .500 inches in diameter. As reported in earlier papers [11, 13], these cylinders had a 0.161-inch hole drilled through them in order to fasten them onto a steel shaft for rotation when immersed in the corroding medium.

Previous studies [11, 13], using this rotating cylinder corrosion test had shown that at rotational speeds over 1900 RPM, diffusional effects were eliminated. Rotation at 2500 RPM was employed in all corrosion tests reported here.

5. *Preparation of Inhibitor Films on Bearing Metal Samples.*

Standard cylinders of bearing metal were immersed for five hours in a white oil solution of inhibitor at 140 C. Inhibitor concentrations employed were those listed in Table 1. After treatment, the cylinders were removed from the oil solution, cooled and washed with petroleum ether, then with ethyl ether and dried. These treated cylinders were prepared just before they were required for subsequent experimental use, in order to minimize any oxidation by the air or other damage to the surface film.

The temperature of 140°C employed for film formation was selected as being more representative of actual bearing temperatures than the 100°C selected for corrosion tests. This latter temperature was dictated by the instability of the t-butylhydroperoxide at higher temperatures. Table 2 indicates the appearance of the treated cylinders and gives the changes in weight of the cylinders due to the surface treatment.

With Inhibitor B, a number of duplicate surface treated cylinders were prepared and total sulfur and phosphorus in the coating on each was determined by chemical analysis. The average analysis of the treated cylinders indicated a content of .00090 grams of sulfur and .00041 grams of phosphorus, with a slight variation between the different cylinders analyzed, indicating that the films could be duplicated.

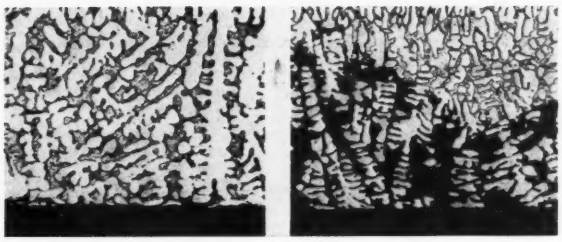


Fig. 1

TABLE 1

COMMERCIAL BEARING CORROSION INHIBITORS

Designation	Type	Chemical Composition % S	% P	% Zn	% $CaSO_4$ Ash	% by Wt. of Inhibitor in Crankcase Lubricant
A	Organic Phosphite	...	10.3	...	...	0.09
B	Organic Phosphorus Sulfur Compound	13.7	5.0	...	...	0.60
C	Zinc Organic Dithiophosphate	7.6	3.4	3.7	...	1.20
D	Metal Phenate Sulfide	2.6	...	...	7.0	2.04
E	Metal Phenate	...	...	...	5.5	4.20

TABLE 2

EFFECT OF CORROSION INHIBITOR TREATMENT ON COPPER-LEAD TEST CYLINDERS

Inhibitor Used	Average Change in Wt. of Cylinder During Treatment (Mg./Sq. Cm.)	Appearance of Surface Film	Type of Surface Film
A	+ 0.54	White	Heavy
B	0.0	Dark Brown	Heavy
C	— 0.23	Dark Brown to Black	Heavy–Porous
D	— 0.08	Pale Orange	Thin
E	— 0.12	Pale Orange	Thin

TABLE 3

REDUCTION OF PEROXIDE BY CORROSION INHIBITORS AT 100°C

Test Solution—0.04 N t-Butylhydroperoxide
Plus 0.1 N Lauric Acid in White Oil

Inhibitor	Inhibitor Per Cent	Peroxide Concentration Min. 0	Min. 5	Min. 15	Min. 30	Min. 45	Min. 60	Min. 90
None; thermal decomposition		.0415	.0400	.0300	.0195	.0132	...	.0070
A	0.09	0.385	.0272	.0247	....	.0104	.0070	....
B	0.60	.0392	.0310	.0183	.0087	.0047	.0018	....
C	1.20	.0405	.0055	.0026	.0000	....	....	....
D	2.04	.0385	.0220	.0062	.0020	.0005	....	....
E	4.20	.0400	.0235	.0156	.0105	.0059	.0032	....

TABLE 4

DECOMPOSITION OF PEROXIDE BY INHIBITOR FILM AT 100°C

Test Solution—0.04 N t-Butyl-Hydroperoxide
Plus 0.1 N Lauric Acid in Hexadecane

Decomposition Agent	0 Min.	5 Min.	15 Min.	20 Min.	30 Min.	45 Min.	60 Min.	75 Min.
Blank; No Cylinder	100	96.4	72.0	...	47.0	31.8	23.0	18.2
Untreated Test Cylinder Surface	100	62.5	35.0	...	...	5.8	...	...
Inhibitor A	100	63.5	...	14.5	...	4.1	...	...
Inhibitor B	100	73.3	...	17.6	...	7.2	...	...
Inhibitor C	100	62.3	...	21.1	...	3.9	...	...
Inhibitor D	100	62.2	...	30.2	...	3.7	...	...
Inhibitor E	100	59.1	...	10.0	....	4.8	...	...

In determining corrosion rates with these surface treated cylinders, a series of duplicate cylinders were immersed in separate portions of the standard corroding medium. Removal of a cylinder at the end of 5, 10, 15, 30, and 45 minutes gave a series of weight losses from which a composite corrosion curve was drawn. This technique avoided the necessity of withdrawing a single specimen, weighing it and then replacing it in the corroding bath, a method which might produce changes in the surface films, and during the time of withdrawal and replacement would permit considerable drop in peroxide concentration due to the continuing thermal decomposition of the peroxide. Analysis on duplicate films formed with Inhibitor B, and the ability to duplicate test results indicated that the treated specimens prepared with a given inhibitor were reasonably uniform.

6. *Hydrocarbon Media.*

Pure hexadecane, obtained from the Connecticut Hard Rubber Company, was washed with concentrated sulfuric acid, then water, and dried. After refluxing the dried product with metallic sodium for two hours, it was finally distilled through an efficient fractionation column and the middle fraction, consisting of about two-thirds of the hydrocarbon charge, was collected for use. White oil (175 SUS at 100°F) obtained from the Standard Oil Company of Ohio was employed in several series of tests without further purification. Earlier work indicated similar corrosion results were obtained with purified hexadecane and with white oil, and it was felt that these two materials would be fairly representative of non-aromatic lube oil hydrocarbon types.

7. *Test Conditions.*

Following are tabulated the test conditions employed in this work:

(a) Temperature—100°C.
(b) Volume of Test Solution—160 cc.
(c) Agitation.
  (1) In tests where bearing metal cylinders were used—2500 RPM.
  (2) In all others—2500 RPM using glass stirrer.
  (3) 200 cc. per minute of purified nitrogen blown through each test solution.
(d) Time of Test—varied from 5 to 90 minutes.
(e) Starting Solution Composition.
  .04 N t-butylhydroperoxide.
  .10 N lauric acid.
  in either purified hexadecane or in white oil.

Experimental Results

1. *Rate of Reduction of t-Butylhydroperoxide by Corrosion Inhibitors.*

To the standard starting solution made up in white oil at 100°C, sufficient inhibitor was added to bring the concentration of the solution up to that concentration in which the particular inhibitor is normally used in crankcase oils. Samples of the solution were removed at various time intervals and residual peroxide content determined by the modified method of Wheeler [14].

Results from these experiments are tabulated in Table 3 and shown graphically in Fig. 3. Data on a blank to which no inhibitor was added are also included. Most of the inhibitors exert strong reducing action on the peroxide, with Inhibitors C and D acting quite rapidly as compared with the action of Inhibitor A, which differed but slightly from the blank.

FIGURE 2

CATALYTIC EFFECT IN LEAD CORROSION

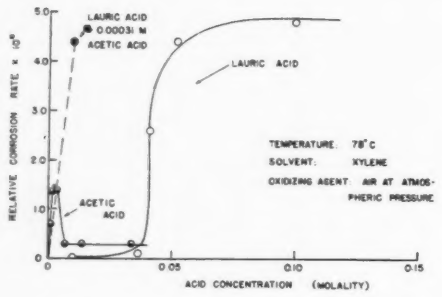


FIGURE 3

REDUCTION OF PEROXIDE BY CORROSION INHIBITORS AT 100°C

TEST SOLUTION: 0.04N t-BUTYL HYDROPEROXIDE + 0.1N LAURIC ACID IN WHITE OIL

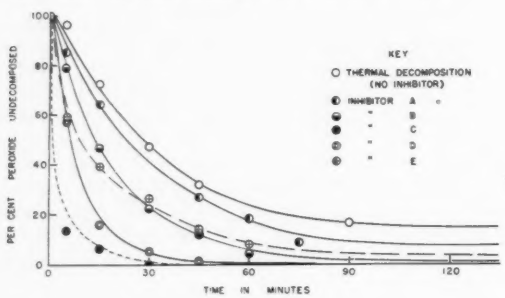


FIGURE 4

DECOMPOSITION OF PEROXIDE BY INHIBITOR FILM AT 100°C

TEST SOLUTION: 0.04N t-BUTYL HYDROPEROXIDE + 0.1N LAURIC ACID IN HEXADECANE

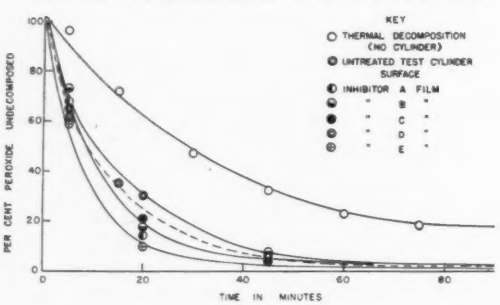


FIGURE 5

CORROSION LOSSES AT 100°C OF INHIBITOR TREATED Cu-Pb TEST CYLINDERS

CORRODING SOLUTION: 0.04N t-BUTYL HYDROPEROXIDE + 0.1N LAURIC ACID IN HEXADECANE

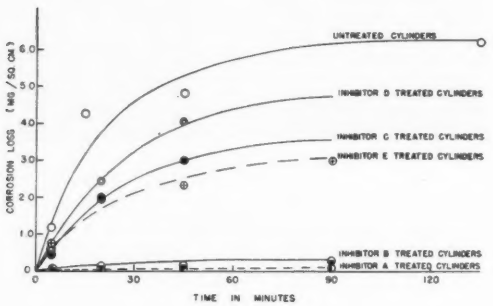


FIGURE 6

CORROSION RATE AT 100°C OF INHIBITOR TREATED Cu-Pb TEST CYLINDERS

CORRODING SOLUTION: 0.04N t-BUTYL HYDROPEROXIDE + 0.1N LAURIC ACID IN HEXADECANE

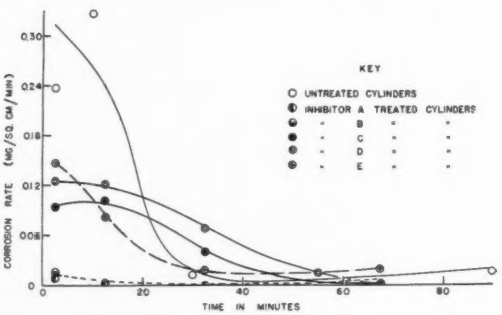
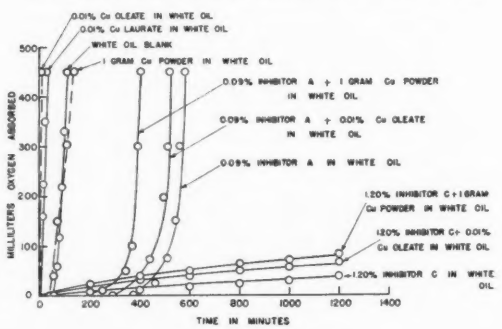


FIGURE 7

OXYGEN ABSORPTION OF WHITE OIL SOLUTIONS CONTAINING ACCELERATORS AND COMMERCIAL CORROSION INHIBITORS AT 140°C


0.01% Cu OLEATE IN WHITE OIL
0.01% Cu LAURATE IN WHITE OIL
WHITE OIL BLANK
1 GRAM Cu POWDER IN WHITE OIL
0.05% INHIBITOR A + 1 GRAM Cu POWDER IN WHITE OIL
0.05% INHIBITOR A + 0.01% Cu OLEATE IN WHITE OIL
0.05% INHIBITOR A IN WHITE OIL
1.20% INHIBITOR C + 1 GRAM Cu POWDER IN WHITE OIL
1.20% INHIBITOR C + 0.01% Cu OLEATE IN WHITE OIL
1.20% INHIBITOR C IN WHITE OIL
MILLILITERS OXYGEN ABSORBED
TIME IN MINUTES

Although 100°C is obtainable in an automotive crankcase, temperatures at bearing surfaces under strenuous operating conditions would probably rise to higher values. At these higher temperatures the rates of reduction by the various inhibitors should be greater than at 100°C, and their relative rates might be altered as well.

Inhibitors which rapidly reduce oxidizing agents at low temperatures might be consumed rapidly in the crankcase and therefore not be sufficiently persistent to maintain inhibition for the duration between oil additions or changes. Such easily oxidized inhibitors would require a considerably greater starting concentration than one which acted mainly at elevated bearing temperatures.

Considering the two inhibitors which contain both phosphorus and sulfur, Inhibitor B reacts more slowly than does C with peroxides at 100°C. In actual engine tests, B used at .60 per cent concentration yields a lubricant containing .030 per cent phosphorus and .082 per cent sulphur, while Inhibitor C at 1.20 per cent concentration produces a lubricant with .041 per cent phosphorus and .091 per cent sulphur. In addition, the bearing loss in weight in the standard L 4 Chevrolet engine

TABLE 5

CORROSION RATES AT 100°C OF INHIBITOR TREATED CU-PB TEST CYLINDERS

Corroding Solution—0.04 N t-Butyl-Hydroperoxide Plus 0.1 N Lauric Acid in Hexadecane

Inhibitor	Time (Min.)	Wt. Loss of Cylinder (Mg./sq. cm.)	△Wt. Loss of Cylinder (Mg./sq. cm.)	Time at △Wt. Loss (Min.)	Corrosion Rate (Mg./sq. cm min.)
None	0	0			
	5	1.19	1.19	2.5	0.238
	15	4.45	3.26	10	0.326
	45	4.83	0.38	30	0.012
	135	6.23	1.40	90	0.016
A	0	0			
	5	0.0495	0.0495	2.5	0.0099
	20	0.0588	0.0093	12.5	0.0006
	45	0.0658	0.0070	32.5	0.0003
	90	0.1283	0.0625	67.5	0.0014
B	0	0			
	5	0.0739	0.0739	2.5	0.0148
	20	0.1121	0.0382	12.5	0.0025
	45	0.1404	0.0283	32.5	0.0011
	90	0.2945	0.1541	67.5	0.0034
C	0	0			
	5	0.4720	0.4720	2.5	0.0944
	20	2.0100	1.5380	12.5	0.1025
	45	3.0190	1.0090	32.5	0.0404
	90	1.9460	0.0000	67.5	0.0000
D	0	0			
	5	0.6250	0.6250	2.5	0.1250
	20	2.4400	1.8150	12.5	0.1210
	45	4.1250	1.6850	32.5	0.0674
	90	3.3990	0.9590	55.0	0.0137
			0.0000	67.5	0.0000
E	0	0			
	5	0.7330	0.7330	2.5	0.1465
	20	1.9750	1.2420	12.5	0.0829
	45	2.2700	0.2950	32.5	0.0180
	90	3.1250	0.8550	67.5	0.0190

test is much lower with Inhibitor B than with C. Thus on a phosphorus and sulfur basis Inhibitor B is considerably more effective as an inhibitor than C.

2. *Effect Upon Peroxide Decomposition and Corrosion Loss Produced by Inhibitor Films on Bearing Metal Surface.*

A series of inhibitor treated copper-lead test cylinders were agitated for various time intervals in separate portions of the standard test solution in hexadecane, and the loss in weight of the bearing metal and peroxide concentration of the solution were determined at various times.

Table 4 and Figure 4 show the data on peroxide decrease, and in Table 5 and Figures 5 and 6 are given the data on corrosion losses and corrosion rates.

These data indicate that the inhibitor treated cylinders do not cause any appreciably greater rate of peroxide disappearance than does a plain untreated sample of bearing metal. However, both the treated and untreated cylinders had a pronounced catalytic effect upon peroxide destruction.

With cylinders treated with Inhibitor B, the total amount of sulfur and phosphorus was determined, and a number of duplicate cylinders were analyzed after contact with the test solution. The loss in sulfur and phosphorus from the surface inhibitor film was equivalent to about one per cent of the total peroxide decomposition occurring. These data give proof that the inhibitor film formed from Inhibitor B on the bearing metal does not react chemically to reduce peroxides, but does function catalytically in peroxide decomposition, however only to the same degree as the untreated metal.

From the corrosion data it may be seen that with an untreated bearing metal cylinder the rate corrosion decreases as the amount of peroxide remaining in solution falls off.

With cylinders treated with Inhibitors A and B, the rate of corrosion is negligible at all times and with varying peroxide concentrations. The films formed from the other inhibitors also had definite retarding effects upon corrosive action during the time when peroxide concentration was high.

With a solution known to be highly corrosive to the lead phase in a copper-lead bearing metal, with a rate of agitation sufficiently high to eliminate diffusional resistances, with the knowledge that the inhibitor treated surface had no greater catalytic action upon peroxide decomposition than that of the untreated metal surface itself, it is highly probable that Inhibitors A and B form surface films which prevent the diffusion of corroding agents into the lead phase of the bearing metal.

In an oil solution containing an adequate concentration of the inhibitor, these surface films would be kept in repair if mechanical abrasion removed a portion of the film material. Films from Inhibitors C, D, and E gave fair protection during the period of test where peroxide concentration was high.

3. *Action of Corrosion Inhibitors in Reducing Rate of Oxidation of Hydrocarbons.*

The rate of oxygen absorbtion of white oil solutions, containing the commercially used concentrations of the five inhibitors was determined at 140°C, using the oxygen recirculation method of Fenske[7], later modified by Larsen and co-workers at the Shell Development Company[8].

Metal Deactivation

Oxidation tests were also made in which .01 per cent of copper oleate was added to each of the inhibitor solutions in white oil, and another series of experiments where 1 gram of finely divided copper powder was added to each solution tested.

Experimental data for these runs are given in Table 6 and Figures 7 and 8.

These data indicate the ability of all inhibitors to maintain quite well their antioxidant abilities even when copper or copper oleate are present in the oil. The catalytic effect or copper and of copper oleate on accelerating hydrocarbon oxidation in the absence of inhibitors is shown by the decreased induction period in the oxidation of white oil containing these agents.

FIGURE 8

OXYGEN ABSORPTION OF WHITE OIL SOLUTIONS CONTAINING ACCELERATORS AND COMMERCIAL CORROSION INHIBITORS AT 140°C

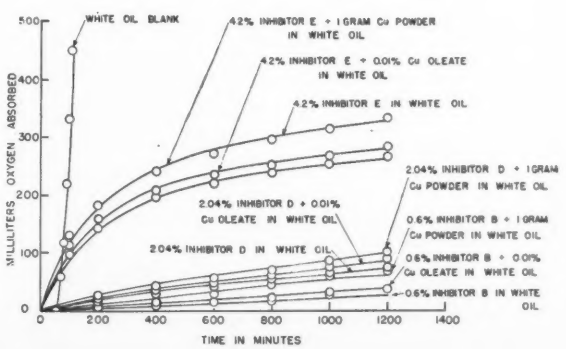

WHITE OIL BLANK
.42% INHIBITOR E + 1 GRAM Cu POWDER IN WHITE OIL
.42% INHIBITOR E + 0.01% Cu OLEATE IN WHITE OIL
.42% INHIBITOR E IN WHITE OIL
2.04% INHIBITOR D + 1 GRAM Cu POWDER IN WHITE OIL
2.04% INHIBITOR D + 0.01% Cu OLEATE IN WHITE OIL
2.04% INHIBITOR D IN WHITE OIL
0.6% INHIBITOR B + 1 GRAM Cu POWDER IN WHITE OIL
0.6% INHIBITOR B + 0.01% Cu OLEATE IN WHITE OIL
0.6% INHIBITOR B IN WHITE OIL
MILLILITERS OXYGEN ABSORBED
TIME IN MINUTES
0
100
200
300
400
500
0
200
400
600
800
1000
1200
1400

TABLE 6

OXYGEN ABSORPTION OF WHITE OIL SOLUTIONS CONTAINING ACCELERATORS AND COMMERCIAL CORROSION INHIBITORS AT 140°C

Inhibitor	Accelerator	Time	Ml. O_2 Absorbed
None	None	55	0
		70	60
		80	118
		90	220
		100	332
		111	450
None	0.01 per cent Copper Oleate	0	0
		10	450
None	0.01 per cent Copper Laurate	0	0
		10	160
		15	225
		20	350
		25	450
None	1 gram Copper Powder	40	0
		60	40
		75	150
		110	304
		140	450
A	None	375	0
		465	25
		515	75
		545	150
		562	300
		585	450
A	0.01 per cent Copper Oleate	290	0
		440	75
		495	200
		515	300
		525	450
A	1 gram Copper Powder	190	0
		250	10
		345	50
		368	100
		380	300
		393	450
B	None	0	0
		200	5
		400	8
		600	12
		800	17
		1000	28
		1200	38
B	0.01 per cent Copper Oleate	0	0
		200	5
		400	10
		600	15
		800	22
		1000	31
		1200	39
B	1 gram Copper Powder	0	0
		200	8
		400	15
		600	30
		800	47
		1000	63
		1200	72
C	None	0	0
		200	8
		400	10
		600	17
		800	24
		1000	29
		1200	38
C	0.01 per cent Copper Oleate	0	0
		200	22
		400	33
		600	40
		800	50
		1000	57
		1200	66
C	1 gram Copper Powder	0	0
		200	25
		400	39
		600	49
		800	63
		1000	72
		1200	84
D	None	0	0
		200	16
		400	30
		600	42
		800	56
		1000	68
		1200	77
D	0.01 per cent Copper Oleate	0	0
		200	20
		400	35
		600	49
		800	64
		1000	78
		1200	91
D	1 gram Copper Powder	0	0
		200	25
		400	41
		600	56
		800	71
		1000	87
		1200	102
E	None	0	0
		100	98
		200	145
		400	198
		600	222
		800	240
		1000	255
		1200	268
E	0.01 per cent Copper Oleate	0	0
		100	115
		200	160
		400	209
		600	235
		800	254
		1000	268
		1200	283
E	1 gram Copper Powder	0	0
		100	132
		200	184
		400	243
		600	273
		800	298
		1000	315
		1200	333

TABLE 7

MECHANISM OF ACTION OF COMMERCIAL BEARING CORROSION INHIBITORS

Inhibitor	Possible Modes of Action						
	Hydrocarbon Oxidation			Inhibition by Films on Bearing Surface			
	Reduces Oxygen Absorbed	Deactivates Metal Catalysts	Changes Products of Oxidation	Reduction of Peroxide in Solution	Catalytic Destruction of Peroxide	Chemical Reaction of Film with Peroxide	Diffusion Barrier
A	Fair	Fair	(Work in progress)	Slow	Positive, but no better than untreated bearing metal	———	Excellent
B	Excellent	Good		Intermediate	"	Very slight reduction of S & P in film ∴ Chemical reaction is slight	Excellent
C	Excellent	Good		Rapid	"	———	Fair
D	Excellent	Good		Rapid	"	———	Fair
E	Fair	Fair		Intermediate	"	———	Fair

Summary

1. The general conclusions on modes of action of the five inhibitors studied are shown in Table 7.

2. Inhibitor films on copper-lead bearing metal did not exert an appreciably greater catalytic effect on hydroperoxide decomposition than did the untreated bearing metal itself.

3. The sulfur and phosphorus in the surface films produced by Inhibitor B on copper-lead bearing metal did not react appreciably with t-Butylhydroperoxide in hydrocarbon solution.

4. Inhibitor films produced by Inhibitors A and B on the surface of copper-lead bearing metal were almost impervious to penetration by corroding agents in the hydrocarbon solution. All other inhibitors formed films with lower resistance to diffusion.

5. All of the inhibitors studied function as antioxidants and metal deactivators in white oil at 140°C.

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DISCUSSION

of Professor Prutton's and Mr. Guttenplan's *"Mechanism of Action of Bearing Corrosion Inhibitors in Crankcase Lubricants"*

The authors are congratulated for the presentation of a most interesting and useful study of bearing corrosion inhibition. Their approach to the problem—first, by a clear-sighted, overall consideration and analysis of the possible mechanisms involved and second by a well planned and ingenious experimental evaluation of each of the possibilities—has resulted in a number of definite and understandable conclusions. This work has organized and clarified a subject which has usually been considered subject only to an empirical treatment.

However, I would like to point out that the corrosive systems investigated by the authors are much simpler in number of components than those that exist in the crankcase of automotive equipment. The presence of contaminants in the oil, other than the acids, oxidants, and copper catalysts considered in this paper, may have a profound effect on the mechanism of bearing corrosion, and entirely change the effect of the five bearing corrosion inhibitors studied. One outstanding type of contaminant I have in mind, are the lead compounds from the fuel. The crankcase oil, from either laboratory engine tests or field source, may contain up to several per cent of lead compounds such as oxides, halides, and sulfates. These lead compounds, present in gross amounts and reactive form, have a very marked tendency to react (similarly to the lead in the bearing) with corrosive acids and with some types of corrosion inhibitors.

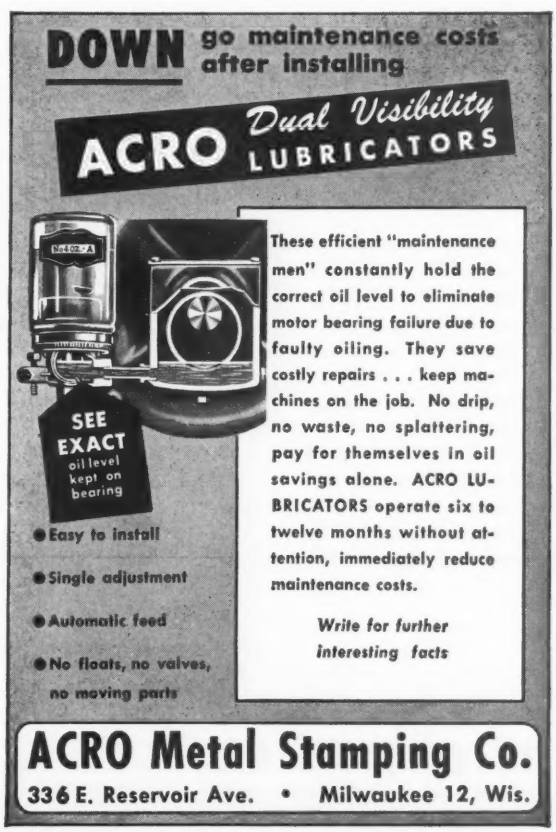
For example, some phosphites and phosphonic acids or salts are mildly effective corrosion inhibitors in the absence of lead compounds from the fuel. When lead salts are present, these phosphorus compounds form lead soaps, which promote oil oxidation and consequently accelerate bearing corrosion. Inhibitor A, the phosphite discussed by the authors, in the presence of lead oxide and halides (1) would probably accelerate, not reduce oxygen absorption, (2) would activate, not deactivate metal (that is, the lead compounds), and (3) would provide a negligibly effective "diffusion barrier" instead of an excellent one.

At least some of the sulfur-type corrosion inhibitors function primarily by reactions with lead compounds to form inactive lead compounds, and the ratio of sulfur inhibitor to lead compounds is quite critical in determining whether the inhibitor will be extremely effective or no good at all.

So far, I have mentioned only lead compounds as possible complicating factors in the picture of bearing corrosion developed by the authors. Certainly the acids and condensed oxidation products from the fuel which contaminate crankcase oil in service are far different in effect from oil oxidation products and often act not to promote bearing corrosion, but to coat metal surfaces with protective films and decrease corrosion.

These comments are made, not to detract from the basic facts presented by the authors in their paper (which is bound to become a standard and oft-quoted reference in any future study of this problem), but merely to point out that the complicating factors encountered in service, may significantly change the relative importance of the different "modes of action" of the various corrosion inhibitors in service.

C. M. Loane, *Standard Oil Co. (Ind.)*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LUBE SPOTS

The echoes of the Buffalo Convention continue to reverberate and each successive conversation brings out new and additional angles about the many papers presented, persons met and exhibits inspected. Any way one looks at it, that Convention was a honey and the one sure statement that can be made, is that all those who missed that "get together," will surely live to regret that slip-up.

Our Bill (Leonard is his other name, in case you didn't know it) and his first principal assistant saw to it that everybody and everything was taken care of. We were unable to figure out how they managed to find enough hours in the day to cater to every whim and fancy.

You know at 50 you are old enough to fully realize that you look awfully silly doing those things which you would do if you were only young enough.

Seriously though, the papers were good, not only because they were varied enough to get everyone's interest, but also they were presented by capable people.

Dr. Fuller's presentation of a proposed program in Lubrication Engineering Education was a live subject with informal discussion groups. Not everyone agreed with the good Doctor's conclusion as there are a lot of clear thinking men who feel that a good educational job can be done right now without reaching for top academic titles. What Lubrication Engineering needs now is factual education, given to earnest people who will want to use such knowledge by rolling up their shirt sleeves and putting learning into practice, thereby demonstrating the value of education. Once enough of such people are in Industry and have definitely proven their necessity, then it would be logical to conclude that men having Ph. D. background will be needed to go after the more or less obscure exact information we all know is now lacking concerning reason for and behavior of a good many things connected with lubrication. At that time, Industry in general may be willing to employ scientists who can direct lubrication from a desk in a private office. Right now though, many lubrication men think we still have a big job in really convincing management that a lubrication engineer is a necessity. We all know that, but we still have to demonstrate the dollar and cents angle to those responsible for making a profit out of business. There, too, of course, were those who felt that as lubrication engineers we should reach for the highest attainable standing in the community as this thing called prestige is a wonderful and awesome thing from the psychological angle.

We don't, for the life of us, know why some designers persist in foisting upon the unwary public, machinery which is doomed to failure from the beginning. A case in point came just recently to our attention. A new worm gear reducer was installed which required two kinds of lubricant. One for the worm gear, another for the bearings. Not only that, but the worm was on top of the gear. Every stopping period drained the lubricant and before any oil could get to the worm teeth, the gear had to make at least a half revolution. You guessed it. Oilers got all screwed up and the equipment went to pot, but quick. If proper study had been given and a competent lubrication engineer had been consulted, a lot of grief and money could have been saved, as in the final analysis a well-engineered unit had to be purchased.

We still can't forget the Convention. The Buffalo boys did themselves proud, even to the point of taking time out to ferry some of the visiting firemen to Niagara Falls and back, of course. The Smoker and Entertainment provided by Buffalo Bill was most enjoyable and also served to bring together old friends with a lot of new ones. It is ever a privilege to meet with Prof. Tichvinsky, as his knowledge of bearing metals and their behavior is a never ending source of good information. Mr. Cadman, too, has always impressed us by having intimate acquaintance with bearing problems, gained through many years of experience. We don't know who is more famous F. O. Hoagland or Pratt and Whitney; at any rate F.O.H. know his subject, and what's more, he knows how to present it. Dr. A. O. Schmidt of Kearney and Trecker, M. E. Merchant of the Cincinnati Mill with Oldacre of Stuart would be a trio par excellence to solve any cutting fluid problems. Oscar Maag seemed to be everywhere. We don't know whether our Society is as good as it was, because last year we got an Oscar. Dr. Mahncke always seems to know what and how. Henry is a good fellow to know.

The exhibitors provided the Convention with the new look. It was good to find out that those who decided to display their wares also had the foresight to staff their showings with very capable personnel. Questions, and there were plenty, always got an intelligent answer. The displays themselves were attractive, in fact, so much so that the lubrication engineers wished they could have free choice of all the equipment offered. That would certainly make their daily work easier and assure more dependable results. Charles Pritchard must have a particularly soft spot in his heart for mechanical equipment. It was hard to get him to take time out to eat. He'd rather investigate what makes the wheels go round.

Well, this just about does it for this time. Will be "seein" you in the next issue.

We are indebted to
OSCAR FROHMAN
of
AMPCO METALS, INC.,
of Milwaukee
for this extremely interesting
critique of the
Buffalo Convention

Action photo of one section of the Lubrication Show, held concurrently with the Third Annual Convention of the American Society of Lubrication Engineers at the Hotel Statler, April 19-21, Buffalo, N. Y.

We are now looking forward to our Fourth Annual Meeting and Second Annual Exhibit which will be held concurrently at the Pennsylvania Hotel, New York City, April 11-13, 1949.

A.S.L.E. EXTENDS ITS THANK YOU!

Many factors contribute to the success of a convention; not the least of which is the unselfish willingness of members to jump in and help wherever and whenever a need arises. Names of such ever ready members are too many to list but honorable mention is certainly in order for several people.

During the assembly of exhibits, by far the handiest man with a hammer and screw driver was Bill Youngclaus of Alemite. By invitation he would go to any booth to demonstrate his agility and prowess with his tools, thereby avoiding many an annoying situation through his efforts. Normally he should have been exhausted when the meetings started; instead it was Youngclaus to the rescue when the projection operator failed to appear and some one had to splice extention cords to get the projector in operation, and incidentally run the machine.

The problem of traffic direction and the operation of a general information bureau and telephone exchange was forced on the D. A. Stuart group, who responded nobly to the challenge. With their booth position near the entry, they were given little choice in the matter, but the responses of Mr. Dykstra and his associates were always quick and courteous. Mr. Dykstra must have decided that since he was taking such an active part in Society affairs, he might as well become a member, for he joined our group during the convention.

The backdrop of the L. E. booth at the Exhibit presented a fitting spot for the outgoing and incoming Presidents of the Society to exchange felicitations. The Society looks forward to a continuation of the fine leadership which Oscar L. Maag, retiring President, has given — under its new President, George L. Sumner.

Left: Oscar L. Maag, Timken Roller Bearing Co., Canton, Ohio.

Right: George L. Sumner, Westinghouse Electric Corp., East Pittsburgh, Penna.

THE CAPTAIN ALFRED E. HUNT MEMORIAL MEDAL

One of the highlights of the Convention was the presentation of the Captain Alfred E. Hunt Memorial Medal, by Dr. E. M. Kipp of the Aluminum Company of America, to Mr. Oscar L. Maag, President of the A.S.L.E. This award is in commemoration of the memory of Alfred E. Hunt, who as an engineer, contributed to the establishment of the Aluminum Company of America.

The purpose of the award is to acknowledge outstanding papers given by members of the Society and formal presentation will be made to an A.S.L.E. member for the best paper offered during a given year at any Section or National A.S.L.E. meeting, or published in the Society's official journal, LUBRICATION ENGINEERING. The length of this paper shall be limited to 5000 words or less and shall deal with the field of lubrication or an allied subject. This is the official award for a full member of the Society, and at a later date, there will be Junior awards.

Mr. Jenno Juszko, the sculptor of the Captain Alfred E. Hunt Memorial Medal, has received the Allied Artists Medal of Honor, and exhibited at leading arts exhibits both in this country and abroad, including Paris, Vienna, Budapest, and Milan.

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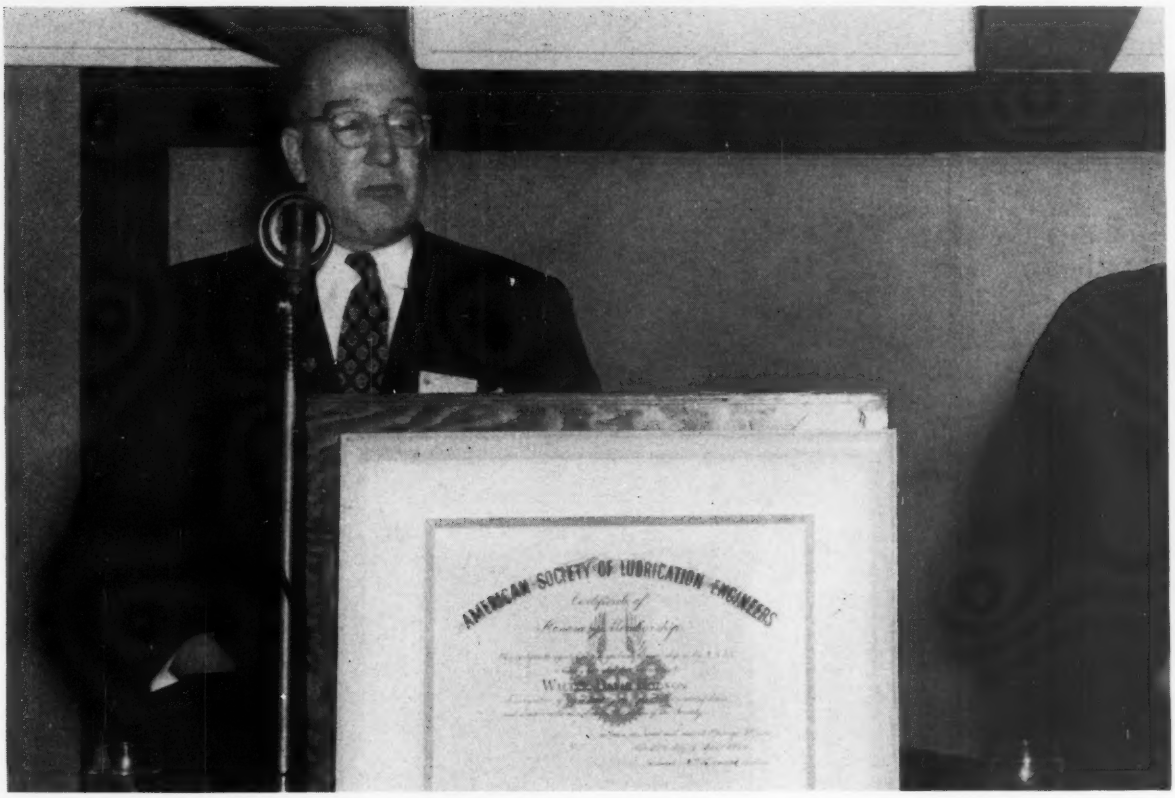

The above photograph illustrates the presentation of the perpetual membership certificate awarded posthumously to Walter David Hodson, and received by his son, W. H. Hodson.

Walter David Hodson was the key originator of the Society, and it was largely through his efforts that A.S.L.E. attained the national stature that it now has.

Mr. Maag, in presenting the certificate to Mr. Hodson, spoke feelingly of the service that Walter David Hodson had given A.S.L.E. and pledged for the Society unwavering adherence to his principles and ideals.

The honorary membership award of A.S.L.E. is bestowed in recognition of an outstanding contribution to the field of engineering and is not necessarily restricted to Lubrication. The recipient need not be a member of the Society, and honorary membership will be called the Walter David Hodson award.

B. H. JENNINGS
Vice President at Large
Professor of Mechanical Engineering
Northwestern University
Evanston, Illinois

W. F. LEONARD
Secretary and Treasurer of
A. S. L. E.
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HENRY E. MAHNCKE
Director and former Chairman of
Program Committee
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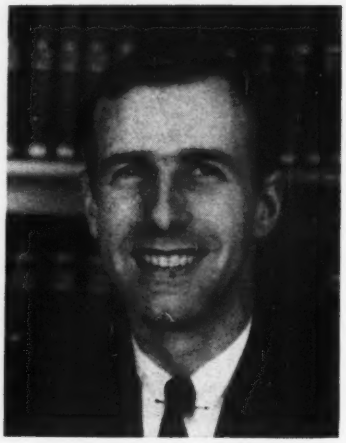
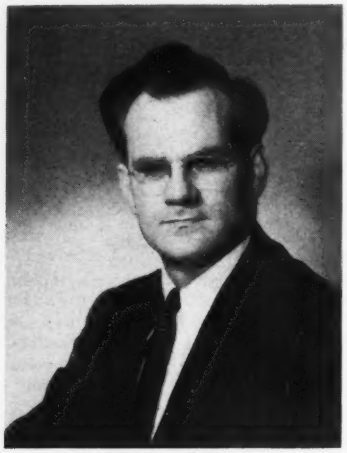


M. E. MERCHANT
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio



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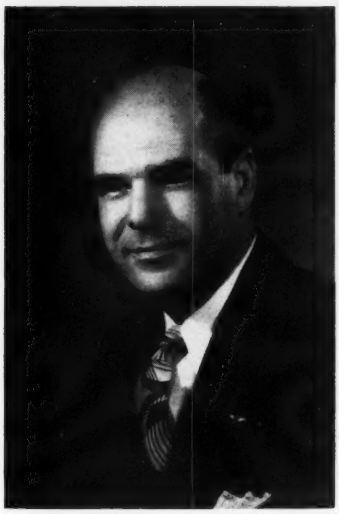
Aluminum Company of America
New Kensington, Pennsylvania

NEWS OF INDUSTRY AND PERSONNEL



Herbert H. Roosa, for the past two years sales manager of Manzel, Inc., has been elected vice-president in charge of sales at a meeting of the board of directors of the company, it was announced today by Ralph F. Peo, president.

Under Mr. Roosa's direction during the past year, the company's sales volume has multiplied fourfold, partially as a result of its expansion into the automotive field. For 50 years the firm has been engaged in the manufacture of force feed lubricators and chemical feeders but more than a year ago began also the production of special tools and maintenance equipment for automobile service stations, particularly for Ford and Lincoln-Mercury dealers.

The company's manufacturing space has been doubled through the erection of a building on property adjoining its older plant.

Mr. Roosa, who studied engineering at Antioch College and later at the University of Michigan, was formerly associated for 10 years with the sales department of the Niagara Machine & Tool Works.

Bulletin 6-A By Bijur

A new booklet fresh off the press, prepared for the mill man, to show typical applications of central lubricating systems in the textile industry. Bijur Lubricating Corporation, 43-01 Twenty-Second Street, Long Island City, N. Y.

NLGI Elects Bennetts

The Board of Directors of the National Lubricating Grease Institute, in a meeting at the Blackstone Hotel, Chicago, unanimously elected Harry F. Bennetts to serve as Executive Secretary of the Institute, and to retain the National office at 4638 Mill Creek Parkway, Kansas City, Missouri. Mr. Bennetts has wide experience in trade association work, is a graduate of the School of Commerce, Northwestern University, and has served in the field of technical experimentation in the laboratory of the Aluminum Company of America.

Lincoln Ball-in-Head Grease Fitting

Wright Appointed to DPW Post by Detroit Mayor

Paul D. Wright, recently Assistant Plant Engineer for the Timken Detroit Axle Company, was appointed by Mayor Van Antwerp to the position of Supt. of Motor Transportation for the city. Mr. Wright is Vice President of the Detroit Section of the A.S.L.E., and his many friends congratulate him on his new affiliation.

Lincoln Announces New, Improved Ball-in-Head Surface Check Kleenseal Bullneck Type Grease Fittings

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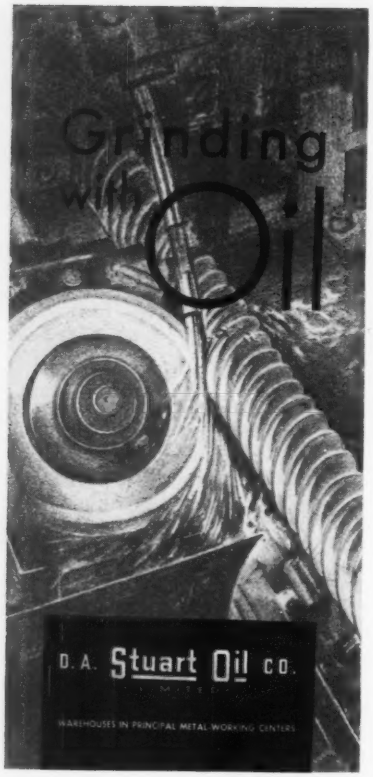

New Revised Edition of Stuart Manual "Grinding With Oil"

A completely revised edition of the booklet "Grinding With Oil," a twenty page catalog and handbook of grinding information, has been published by the D. A. Stuart Oil Company.

Revamped to keep the metal-working industries abreast of rapid changes in grinding with oil, this booklet contains a good deal of data on the application of Stuart oils to precision grinding projects. Tips for handling grinding oils are listed for the convenience of the operator.

This reference handbook is available to men of the metal-working industries without charge by writing the D. A. STUART OIL CO., 2729-53 South Troy Street, Chicago 23, Illinois.

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A typical application is at the hose terminals where lubricant lines are connected to roll neck bearings of rolling mills. Connections on hose lines equipped with Hansen quick-connective couplings are made by hand from the floor level.

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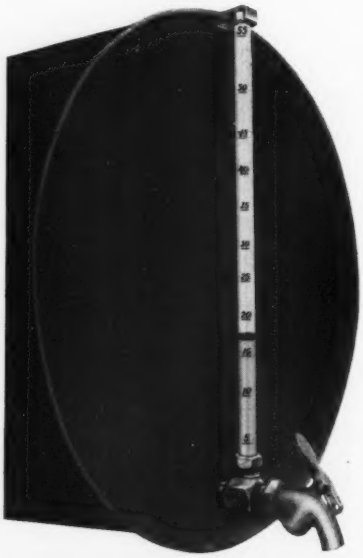

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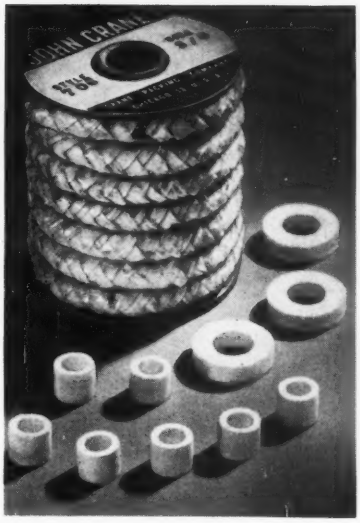

New Appointment for Lassiter

Mr. Clyde M. Lassiter has be appointed Southern sales engineer by the Bijur Lubricating Corporation.

Operating out of Charlotte, he will contact textile mills in Alabama, Georgia, North Carolina and South Carolina. In this territory, Mr. Lassiter will be available for consultation regarding the application of central lubricating systems to textile machinery.

He was formerly associated with the Minneapolis-Honeywell Regulator Company, Brown Instrument Division.

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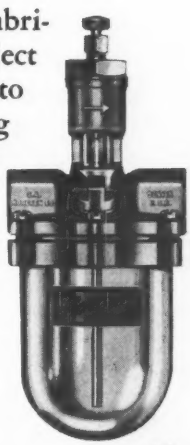

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NEWS OF THE SECTIONS

Sectional Meeting at A.S.L.E. Convention

On April 18, 1948, at 4:00 P.M., at the Statler Hotel in Buffalo, New York, the Second Annual meeting of the Sectional Officers was held, twelve Sections of our Society being represented. It was a fine general discussion of Sectional problems and it enabled us, not only to get acquainted personally, but to centralize the various problems confronting each of the different localities. These difficulties, while being local in nature, are similar in effect. We think that these meetings each year will do much to stimulate the activities of the Society as a whole, and bring us closer together in the realization of the aims and purposes of our Society.

MILWAUKEE

April found this Section with a new slate of Officers and more than enough enthusiasm to speak well for a big year. The new Officers follow:

Chairman—A. Boie, Allis-Chalmers Mfg. Co.

Vice Chairman—R. Bussard, Ladish Co.

Secretary—H. Hofmeister, Socony-Vacuum Co.

Treasurer—D. Johnson, Standard Oil Co.

Two Directors elected for two years:

C. Peterson, Falk Corp.

W. Alexandroff, Pate Oil Co.

The Officers were installed at the May meeting. The installation was followed by several fine sport films, some singing and a very good lunch and refreshments. A very fine finish for a successful year and a good start for the new Officers.

Reports from the Convention show that this Section had nine members present and several exhibitors. Those who attended were very well pleased with all phases of the Convention and are looking forward to next year.

Philadelphia Section Closes Successful Season

This Section brought to a close its season's activities with a meeting at the Broadwood Hotel, Philadelphia, on May 6th, which followed their regular monthly dinner. The meeting was in the form of a symposium and round-table discussion and featured the Care and Application of Lubricants. Mr. Charles L. Warnecke, Lubrication Engineer of the Armstrong Cork Company at Lancaster, Pennsylvania, led off with a paper entitled "A Consumer's Method of Care, Application and Handling of Lubricants," pointing out the methods and systems used by his company and emphasizing the necessity for employing men of the calibre of first-class millwrights in handling and application of lubricants.

Mr. Charles H. Foster of the Atlantic Refining Company followed with a talk on "Handling of Lubricants from Producer to Consumer," describing in detail the care which is given the packing and handling by the producer to the ultimate user, stressing the responsibility of the oil companies, lubrication engineers, management and the A.S.L.E., to provide an ever increasing amount of information on this important subject.

Mr. John H. Dunigan, Lubrication Supervisor of the SKF Industries, spoke on "Atomized Spray Application of Lubricants to High Speed Roller Bearings," bringing out a new and revolutionary development in the application of oil to anti-friction bearings involving the delivery of the lubricant to the bearing in the form of a fog. Mr. Dunigan stressed the resultant savings of lubricant, lower bearing temperatures and longer life.

This final meeting was a fitting climax to a very successful '47-'48 season of the Section and stimulated a great deal of interest and discussion. Philadelphia has more than doubled its membership during the past year and each one of the five meetings held have been interesting and have covered a wide variety of subjects. The following list of Officers have been elected for the next season:

Chairman—Mr. Wm. Kuebler—Westinghouse Electric Corp.

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Secretary—Mr. K. E. Simminger—Bowser, Inc.

Treasurer—Mr. J. L. Beatty—L. R. & J. L. Beatty Co.

Mr. Truxton B. Ryan, as retiring Secretary, received the thanks from the membership of his very excellent handling of the difficult job during this past season.

INDIANAPOLIS

The Indianapolis Section held their regular monthly session on April 26th at the Severin Hotel. Mr. Norman C. Penfold, Mid-Western Vice President of the A.S.L.E., gave a very interesting talk on "Trends in Lubricant Development as Effected by Engine Design." Mr. Penfold accompained his talk with slides showing test methods and results. There was much interest displayed in this subject, and a long discussion of the many points brought out followed.

This Section is making very rapid strides and growth, and was well represented at the National Meeting in Buffalo. Mr. J. E. Burns, Jr., Mr. I. S. Bigger and Mr. Don Wilson were among those in attendance at the National Meeting.

PITTSBURGH

The regular monthly meeting of the Section was held at the Windsor Hotel, Wheeling, W. Va., on May 21st. A large attendance enjoyed a very excellent dinner, and the meeting opened at 8:15 P. M. The subject chosen for the evening was "Oil Seals and Their Application to Industrial Machinery," with F. R. Magill and Wayne Ritter of the F. R. Magill Company heading the discussion. This will be the last meeting of the present season, and Mr. Goddard, Secretary, reports that they have had a heavy increase of membership this year and are looking forward to resumption of activities in the fall.

(*Continued on page* 142)

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*Denotes Residence Address Preferred.

NEWS OF THE SECTIONS

(*Continued from page* 140)

DETROIT

At a meeting of the Detroit Section at the Horace H. Rackman Educational Memorial, following the usual dinner at 6:30 P.M., (which was well attended), a large audience listened to Charles M. Heinan, Lubricants Laboratory of the Chrysler Corp., talk on "Cold Weather Starting" which was cleverly illustrated with slides depicting engine operation and car performance under varying conditions.

A lively discussion followed the delivery of the paper, and the thanks of the Section was given to Mr. Heinan for his efforts.

Through the courtesy of Mr. P. M. Stinson, the members were privileged to see the sound movie "Motor City Four."

Mr. Robert L. Holmes has announced that he is leaving for Arizona and it is hoped that he will see fit to return shortly to Detroit. The Section will miss his efficient handling of the Secretary's job.

BUFFALO

The regular monthly dinner meeting was held at the General Brock Hotel, Niagara Falls, Ontario, on Friday, May 14th, at 6:30 P.M.

Mr. Brian Malley of Toronto, Ontario, a member of the Industrial Department of the Shell Oil Company, Ltd., gave a very interesting talk on the subject of "Problems at the Arctic Circle," bringing out many points concerning the testing and operation in the frigid zone.

This was followed by a motion picture "10,000 Feet Deep" which created much interest.

A very lively discussion followed Mr. Malley's remarks, and his complete coverage of the subject was much appreciated.

BALTIMORE

The regular meeting of the Section was held April 28th, at the Sears Community House, North Avenue and Harford Road, Baltimore. Dr. J. I. Clower was the speaker of the evening on the topic of "Principles of Bearing Lubrication." Dr. Clower handled the subject in his usual sparkling manner and supplemented the talk with slides. Animated discussion followed, and Secretary Staines announced that their next meeting will be on May 25th at the same quarters. The following Committee members were appointed:

R. M. COKINDA, *Finance*
P. F. CHAPPELL, *Membership*
JAY TREXLER, *Program*

The meetings of the Baltimore Section are creating unusual interest in engineering circles in that city.

LOS ANGELES

Mr. R. L. Engel, Secretary of the Los Angeles Section, sends in a report of their 15th regular meeting held at the Auditorium of the Ethyl Corporation in that city at 8:00 P. M. Tuesday, May 11th, on the overall subject of "Lubricating Greases." The paper was delivered by Mr. Don E. Bowers of General Petroleum Corporation, who described the manufacturing methods in general use and also discussed the influence of various soap bases on the physical properties of the finished product, and explained the methods and tests used to evaluate performance and the identification of types. Mr. Fred V. Hall was appointed Chairman of the Membership Committee and Mr. Frank H. Ott to the Chairmanship of the Planning, Program, and Publicity Committee.

NORTHERN CALIFORNIA

The monthly meeting of this Section was held at the Officers' Club, Treasure Island, April 6th. The meeting was preceded by the usual refreshments period and a turkey dinner was served at 7:00 o'clock. The meeting opened at 8:30 P.M., when Mr. Paul Ruedrich introduced the speaker of the evening, Mr. Frank Ross, National Sales Engineer of the E. F. Houghton Co., Cleveland. Mr. Ross gave his popular talk with variations on "Confused Lubrication" and emphasized the great service that the A.S.L.E. could offer both the consumers and manufacturers of lubricants.

Following the question period, Mr. Isbell announced that on May 6th, the Section would hold a session on "Rust Preventives and Trends in Automotive Lubrication."

NEW YORK

A dinner meeting held on March 10th, was followed by the presentation of a very interesting paper on "Thin Film Lubrication" by Mr. W. Claypoole of Columbia University, who produced data on experimentation with a specially designed friction machine in which basic data on static solid friction as well as friction generated by monomolecular layers of well defined lubricants on clean glass surfaces were obtained. The discussion of the paper was led by Dr. W. E. Campbell of Bell Telephone Laboratories, Murray Hill, New Jersey, who placed particular emphasis on solid static friction of different metals.

The closing dinner meeting of the season has been scheduled for May 11th, when Mr. R. C. Adams of the U. S. Naval Engineering Experiment Station, Annapolis, Md., will present a paper on "Development and Appraisal of Lubricant Testing Procedures."

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OILS AND LUBRICANTS PATENT ABSTRACTS

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 607, No. 4; Vol. 608, Nos. 1, 2, 3, 4, 5; Vol. 609, Nos. 1, 2, 3, 4.

Prepared by ANN BURCHICK

Sulfurized Oil-Aromatic Oil Compositions—Patent #2,436,457—Frank J. Soday, assignor to The United Gas Improvement Co.

A composition of matter comprising 10% to 90% of a sulfurized fatty oil and 90% to 10% of a hydrocarbon oil which has been physically separated from tar produced in the vapor phase pyrolysis at average temperatures above 1300°F. of petroleum oil and which hydrocarbon oil boils above 210°C. but is free from and of greater volatility than the pitch of said tar, said hydrocarbon oil having an aromatic hydrocarbon content of at least 90%, and also being substantially free from resin-forming material.

Lubricating Oil—Patent #2,436,565—Donald B. Gillett, assignor to Standard Oil Development Co.

An improved lubricating oil comprising a major portion of substantially wax-free oil in the lubricating oil range separated from a paraffin base crude petroleum, a minor portion of wax separated from a naphthenic base crude petroleum and a minor portion of the condensation product formed by condensing chlorinated paraffin wax with an aromatic hydrocarbon.

Compounded Lubricated Oil—Patent #2,436,589—John P. McDermott, assignor to Standard Oil Development Co.

A mineral lubricating oil containing dissolved therein an oxidation-inhibiting amount of zinc isopropyl xanthate.

Hydrocarbon Fuel Oil—Patent #2,437,041—Wayne A. Proell, assignor to Standard Oil Company.

A normally liquid hydrocarbon fuel oil, normally susceptible to the formation of non-casual sediment and which normally causes clogging of small apertures, containing a filtered technical grade phosphatide substantially free of liquid hydrocarbon precipitable constituents, obtained by dissolving said phosphatide in a hydrocarbon solvent, and filtering the mixture, said filtered phosphatide being used in small but sufficient amounts to inhibit the clogging tendency of said hydrocarbon fuel oil.

Glyceride Oil Refining with Foots Softening Agent—Patent #2,437,075—Benjamin Clayton, assignor, by mesne assignments, to Benjamin Clayton, doing business as Refining Unincorporated.

In the art of refining animal and vegetable oils wherein impurities are removed in the form of aqueous foots by centrifugal separation, the improvement which comprises the step of separating the foots by centrifugal separation in the presence of a softening agent for said foots selected from the group consisting of abietic acid, naphthenic acid, and water soluble soaps of such acids, the amount of said agent being sufficient to substantially soften said foots.

Emulsions Containing a Drying Oil-Ester Resin Copolymer—Patent #2,437,293—Wm. H. Butler, assignor to Bakelite Corp.

Aqueous emulsion comprising as an essential ingredient a copolymerization product of a drying oil with an ester obtained in reacting a cyclo-pentadiene-maleic adduct, a fatty acid having from 5 to 22 carbon atoms in the chain and a polyhydric alcohol.

Preparation of Improved Drying Oils—Patent #2,437,343—Edward S. Barnitz, assignor to Distillation Products, Inc.

The process of preparing an improved drying oil which comprises in combination, subjecting the oil which contains polymerizable constituents to a treatment for removal of at least part of the nonpolymerizable constituents, subjecting the remaining portion of the oil to a bodying treatment, subjecting the bodied oil to high vacuum unobstructed path distillation and separating a substantial portion of unpolymerized oil as a distillate.

Process for the Refining of Hydrocarbon Oil Containing Mercaptans—Patent #2,437,348—Kenneth M. Brown and Clarence G. Gerhold, assignors to Universal Oil Products Co.

In the refining of hydrocarbon oil containing mercaptans by treatment thereof with a solution comprising an alkali and an organic solvent selected from the group consisting of methanol, ethanol, propanol, acetone, ethylene glycol, and glycol ethers, the method which comprises separating said solution from the treated oil and distilling the same to vaporize mercaptans and organic solvent from the alkali, condensing the vapors to form a mercaptan layer and a solvent layer containing a small amount of mercaptans, separating said solvent layer from the mercaptan layer, contacting the separated solent layer in the absence of said mercaptan layer with hydrocarbon liquid to reduce the mercaptan content of the solent layer, and separating the solvent of reduced mercaptan content from said hydrocarbon liquid.

Hydrobleaching Glyceride Oils—Patent #2,437,706—William J. Paterson, assignor to Lever Brothers Co.

A process for hydrobleaching glyceride oils comprising treating the oil at a temperature of the order of about 170 to 250°C. with hydrogen under superatmospheric pressure for not more than about 60 minutes in the presence of not more than about 0.5% of a copreciptated catalyst having the general formula Fe-X-O, in which X represents at least one metal selected from the group consisting of copper, silver and gold.

Lubricant and Hydraulic Fluid Composition—Patent #2,438,446—Hollis L. Leland, assignor to Standard Oil Development Co.

A composition of matter consisting essentially of nuclearly chlorinated cumenes containing an average of 2.5 to 4.0 atoms of chlorine per mol of cumene, and 2 to 20% by weight of a linear organic polymer thickener selected from the group which consists of polymerized isobutylene, acrylic acid esters, and methacrylic isobutylene, acrylic acid esters, and methacryiic acid esters, said polymer thickener having a molecular weight within the range of 1,000 to 15,000.

Cutting Oil Composition—Patent #2,438,461—Jere C. Showalter, assignor to Standard Oil Development Co.

A composition of matter capable of forming a substantially stable aqueous emulsion comprising a major portion of a sodium hydroxide neutralized sulfonated extract of a naphthenic type petroleum oil and a metal salt of stearic acid in an amount sufficient to prevent foaming of the emulsion.

Oil Composition—Patent #2,438,468—Jones I. Wasson and Carroll J. Wilson, assignors to Standard Oil Development Co.

An oil composition having a high resistance against oxidation comprising a petroleum oil boiling in the lubricating oil range and a relatively small amount, sufficient to substantially inhibit deterioration, of tertiary butyl ether of 4-isopropyl alpha naphhol.

Lubricating Oil Composition—Patent #2,438,599—Edward S. Blake, assignor to Monsanto Chemical Co.

A composition of matter comprising an admixture of a hydrocarbon lubricating oil base admixed with minor amounts sufficient to impart E.P. properties to the lubricant of a chlor phenalkyl ester in which the ester forming group consists of carbon, hydrogen and chlorine of a thio acid the chlorine being attached to the phenyl nucleus of the said phenalkyl group.

Mineral Oil Composition—Patent #2,438,876—Orland M. Reiff and Harry J. Andress, Jr., assignors to Socony-Vacuum Oil Co., Inc.

An improved mineral oil composition comprising a mineral oil having admixed therewith a minor proportion, sufficient to stabilize said mineral oil against oxidation, of a metal salt of a diaryl sulfide of an alkyl-substituted diaryl dithiophosphoric acid, the alkyl substituent of which is an oil-solubilizing alkyl group containing at least about ten carbon atoms.

Utilization of Tall Oil—Patent #2,439,377—Martin K. Bare and Warren Stubblebine, assignors to Armstrong Cork Co.

In a method of utilizing tall oil to form a siccative oil-resin-tall oil gel, the step of mechanically oxidizing a siccative oil in the presence of tall oil and a resin, said tall oil being present in an amount equal to at least 10% by weight of the total weight of these gel ingredients.

Method and Apparatus for Dewaxing Oils—Patent #2,439,434—Hans Olof Lindgren, assignor to Aktiebolaget Separator-Nobel.

In the process of dewaxing mineral oils, tars, distillation and transformation products thereof and similar products, in which the wax-bearing oil is chilled in countercurrent heat exchange relation to a flowing heat absorbing liquid and in which wax and substantially wax-free oil are separated from the chilled wax-bearing oil and in which the separated dewaxed oil is utilized as the heat absorbing liquid, the improvement which comprises maintaining throughout the heat exchange system a predetermined temperature differential between the heat-absorbing dewaxed oil and the wax-bearing oil by chilling with a chilling medium the dewaxed oil in the course of its flow in heat exchange relation with the wax-bearing oil.

Oil for Industrial Purposes and Manufacture Thereof—Patent #2,439,729—Henri Martin Guinot and Armand Courtier, assignors to Les Usines De Melle.

In a process for the manufacture of oils, the step of introducing ethylene at substantially atmospheric pressure into a stirred suspension of an aluminum chloride catalyst in a mixture of naphthalene with at least one substance selected from the group consisting of benzene, ethylbenzenes, benzene higher homologues and ethylbenzene higher homologues, at a temperature from about 30°C. to about 140°C., so as to cause ethylation of naphthalene.

Lubricating Oil Additives—Patent #2,439,734—Chester M. Himel and Grant C. Bailey, assignors to Phillips Petroleum Co.

An improved lubricant comprising a major proportion of a lubricating oil and as an oxidation inhibitor therefor an unsubstituted alkyl sulfenamide, said sulfenamide being present in an amount ranging from 0.01 to 5 per cent by weight of said oil.

High Efficiency Lubricants—Patent #2,439,819—John M. Musselman, assignor to The Standard Oil Co.

A compound of a heavy metal selected from the group consisting of chromium and metals below iron in the E.M.F. series and the reaction product of a sulphide of phosphorus and an oxygen-containing wax reacted at a temperature to separate a phosphorus and oxygen-containing residue.

Compound Lubricants—Patent #2,439,820—John M. Musselman, assignor to The Standard Oil Co.

Compounds of a heavy metal selected from the group consisting of chromium and metals below iron in the E.M.F. series and of a metal selected from the group consisting of barium and metals having not more than four electron orbits selected from groups I, II, and III of the periodic system, and the reaction product of a sulphide of phosphorus and an oxygen-containing wax reacted at a temperature to separate a phosphorus and oxygen-containing residue.

Lubricant Preparation—Patent #2,439,821—John M. Musselman, assignor to The Standard Oil Co.

As a composition of matter suitable for use as a lubricant and as an addition agent to improve the characteristics of lubricating oils, a dual-reactive metal compound of the reaction product of a phosphorus sulfide and an ester wax reacted at a temperature at which most of the phosphorus of the phosphorus sulfide separates from said reaction product.

Lubrication—Patent #2,439,954—John V. Tercho, assignor to Westinghouse Electric Corp.

A flood-lubricating means for a lubricated device having an approximately horizontal rotating shaft, a bearing for supporting the shaft at each end of the lubricated device, and a shaft-driven oil pump at one end of the device, said flood-lubricating means comprising an oil-tank centrally disposed alongside of said lubricated device, said oil tank having a partition dividing the same into an oil reservoir and a pressure-oil chamber, an oil-line to the pump from the oil reservoir, an oil-line from the pump to the pressure oil chamber, the device including means providing a pressure-relieving oil passageway for discharging some of the oil pumped by said pump, two oil-lines of approximately identical oil pressure characteristics from the pressure oil chamber to the respective bearings for flood lubricating the same, and an oil-line from each bearing to the oil reservoir for draining oil from each bearing.

Oil-Ring and Flood-Lubricated Bearing—Patent #2,439,955—John V. Tercho, assignor to Westinghouse Electric Corp.

A combination oil-ring bearing and flood-lubrication bearing, comprising a sleeve-bearing for journalling an approximately horizontal rotating shaft, said sleeve bearing having a housing having an oil chamber in its lower portion and having a slot in its upper portion, an oil ring for lifting oil from the oil chamber to the top of the journal, the slot being so shaped and dimensioned that the oil ring may be inserted and removed therethrough, a removable slot cover having a downwardly depending oil pipe extending into close juxtaposition to the top of the oil ring, an oil supply coupling means for feeding oil through said oil pipe, and an oil overflow drain line from said oil chamber.

Treatment of Drying Oils—Patent #$2,440,000—Henry G. Berger and George S. Crandall and John F. Socolofsky, assignors to Socony-Vacuum Oil Co., Inc.

In a process of preparing a liquid coating composition, the steps which comprise polymerizing a drying oil containing a polymerization catalyst of the Friedel-Crafts type at a temperature not substantially above about 300° F. to a body not substantially lowed than Z-6 (Gardner-Holdt scale), arresting polymerization of said oil before gelation thereof occurs by addition thereto of water in an amount sufficient to exert an arresting action but insufficient to form a separate phase and thereafter adding resin, thinner, and drier to form the said composition.

Lubricating Oil—Patent #2,440,375—Rush F. McCleary, assignor to The Texas Company.

An improved lubricating oil comprising a mineral lubricating oil having incorporated therein a small pro-

portion of an oil soluble metal salt of a compound which is the reaction product of a methylolforming aromatic compound with equimolecular quantities of formaldehyde and a secondary amine.

Synthetic Drying Oils—Patent #2,440,459—Herman S. Bloch, assignor to Universal Oil Products Co.

A process for the production of synthetic drying oils which comprises reacting an olefinic hydrocarbon charging stock in the presence of a conjunct polymerization catalyst comprising hydrogen fluoride to form a catalyst-hydrocarbon complex, separating the resultant reaction products into a hydrocarbon phase and a catalyst phase comprising said complex and relatively saturated higher boiling compounds, extracting said catalyst phase with a substantially non-reactive solvent boiling below about 250°C. under conditions to remove said relatively saturated higher boiling compounds without effecting conversion of said solvent, said solvent being substantially inert toward and substantially immiscible wih said complex, and separating from the thus extracted catalyst phase a hydrocarbon drying oil substantially free of said compounds.

Synthetic Drying Oils—Patent #2,440,477—Warren W. Johnstone, assignor to Universal Oil Products Co.

A process for the preparation of a drying oil which comprises reacting a hydrocarbon fraction containing olefins in the presence of a hydrogen fluoride catalyst, separating the reaction mixture into a catalyst phase and a hydrocarbon phase, removing hydrogen fluoride from said catalyst phase thereby leaving a residual organic material, treating said residual organic material with an alaline reagent to neutralize free acid therein, and recovering the acid free organic material as said drying oil.

Oil Desalting Technique—Patent #2,440,617—James E. Seebold, assignor to Standard Oil Co.

In the process of desalting petroleum oil wherein the oil is vigorously contacted with a brine solution, thereafter separated from said solution and the separated brine solution is recycled to the contacting step of the process, the improvement comprising controlling the hydrogen ion concentration of said brine solution by adding an alkali thereto after separation from said oil, thereby producing a precipitate and settling said precipitate from said brine solution before recycling said solution to said mixing step.

Dibasic Acid Drying Oils—Patent #2,440,667—Latimer D. Myers and Victor J. Muckerheide, assignors to Emery Industries, Inc.

As a new product, a drying oil which comprises an oil selected from the class consisting of drying and semi-drying oils in which non-drying constituents are replaced by an aliphatic dicarboxylic acid having a vapor pressure lower than the vapor pressure of the replaced non-drying constituents.

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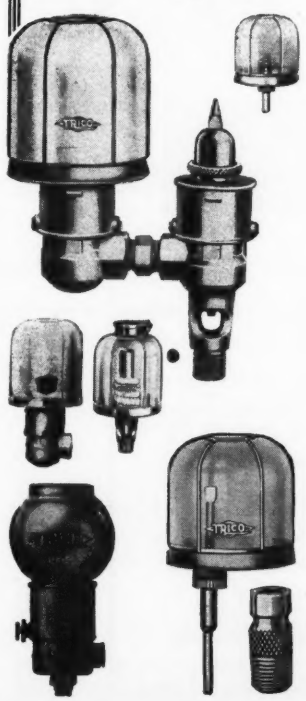

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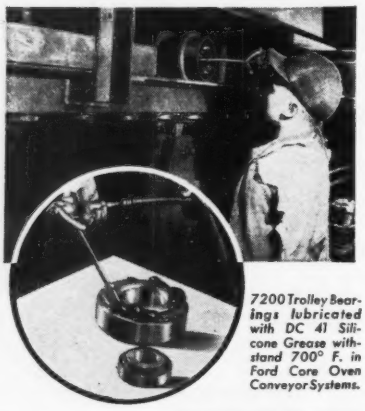
Silicone News

DC SILICONES

Ford Uses Silicone Grease in Bearings at 700° F.



7200 Trolley Bearings lubricated with DC 41 Silicone Grease withstand 700° F. in Ford Core Oven Conveyor Systems.

PHOTO COURTESY FORD MOTOR COMPANY

The cost of designing around the thermal limitations of organic greases is often prohibitive. In such cases, frequent relubrication, high maintenance costs, and production stoppages were inevitable until Dow Corning introduced a line of semi-inorganic silicone greases serviceable at temperatures far above the limits of organic greases.

The economy of this new solution to high temperature lubrication problems is demonstrated in the core oven conveyor systems operated by the Ford Motor Company. These core ovens operate 16 hours a day, 5 days a week, at a peak heat of 700° F. The 7200 trolley bearings are exposed to such temperatures for 2½ hours out of every 4 hours. Even with automatic oiling, the bearings froze, wheels were flattened, and production was interrupted.

After careful testing, Ford's Chemical Engineering Department recommended DC 41 Silicone Grease. Lubricated with this heat-stable silicone grease, the conveyor systems require considerably less power to operate. They start easily and run continuously. Replacement and maintenance costs are greatly reduced and the bearings exposed to 700° F. are relubricated only once a week.

If you have a high temperature or permanent lubrication problem, write for Dow Corning Silicone Grease data sheet No. P 7-2 or call our nearest branch office.

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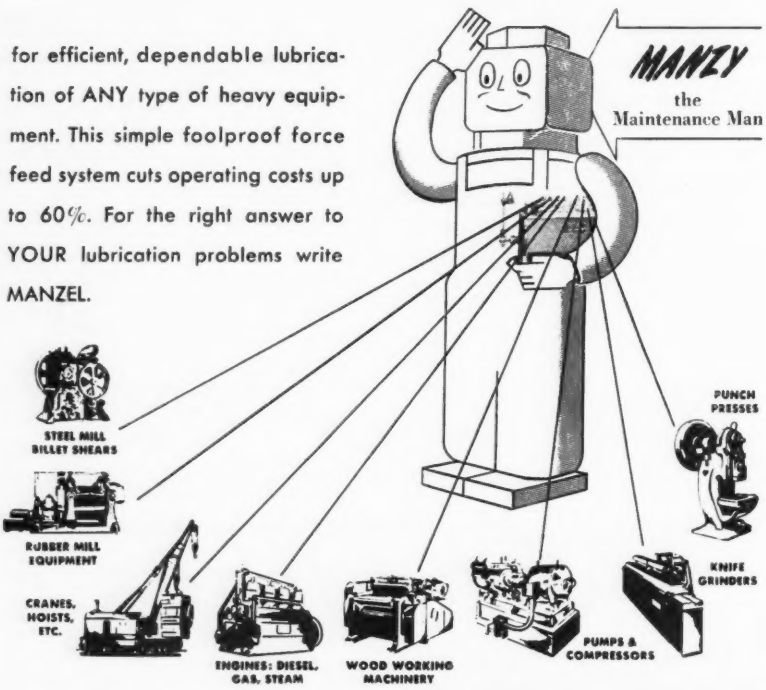

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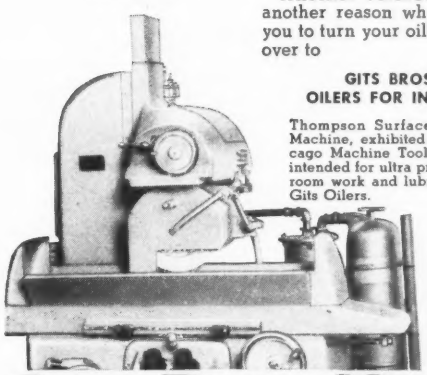

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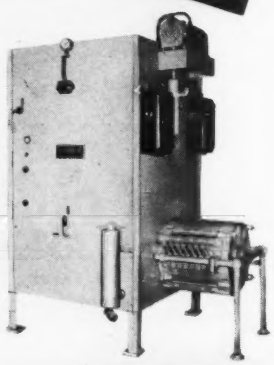

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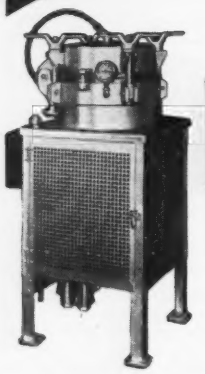

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Acheson Colloids Corp. 108
Acro Metal Stamping Co. 131
Alemite 114
Alox Corporation 141
American Cyanamid Company 116
Aro Equipment Corporation 109
Brace Engineering Co. 146
Burns Laboratories, Inc. 147
Cincinnati Milling Machine Co. 115
Classified 139
Cuno Engineering Corp. 107
Dow Corning Corp. 146
Farval Corporation, The ..... Inside Back Cover
Gits Bros. Mfg. Company 147
Grafo Colloids Corporation 147
Hilliard Corporation, The 148
Hodson Corporation, The ..... Back Cover
Houghton, E. F. & Co. 111
Lincoln Engineering Co. 112
Madison-Kipp Corporation 110
Manzel, Inc. 146
Norgren, C. A., Co. 139
Shell Oil Company, Inc. 143
Sinclair Refining Co. 145
Stuart, D. A., Oil Co., Ltd. 105
Swan-Finch Oil Corporation 106
Tide Water Associated Oil Company 113
Trabon Engineering Corporation ..... Inside Front Cover
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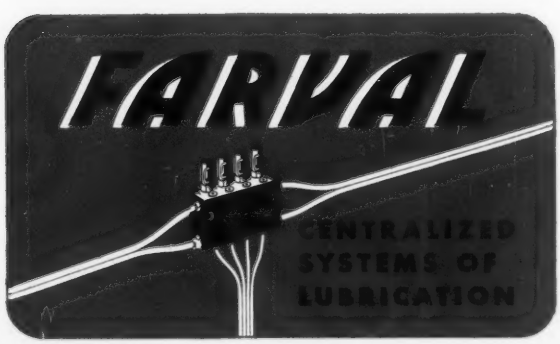

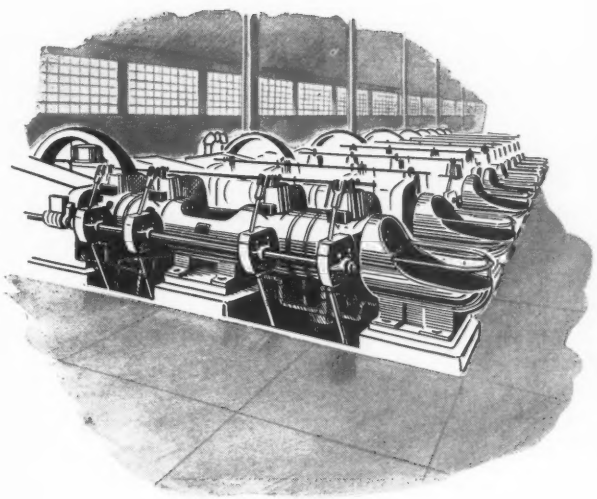

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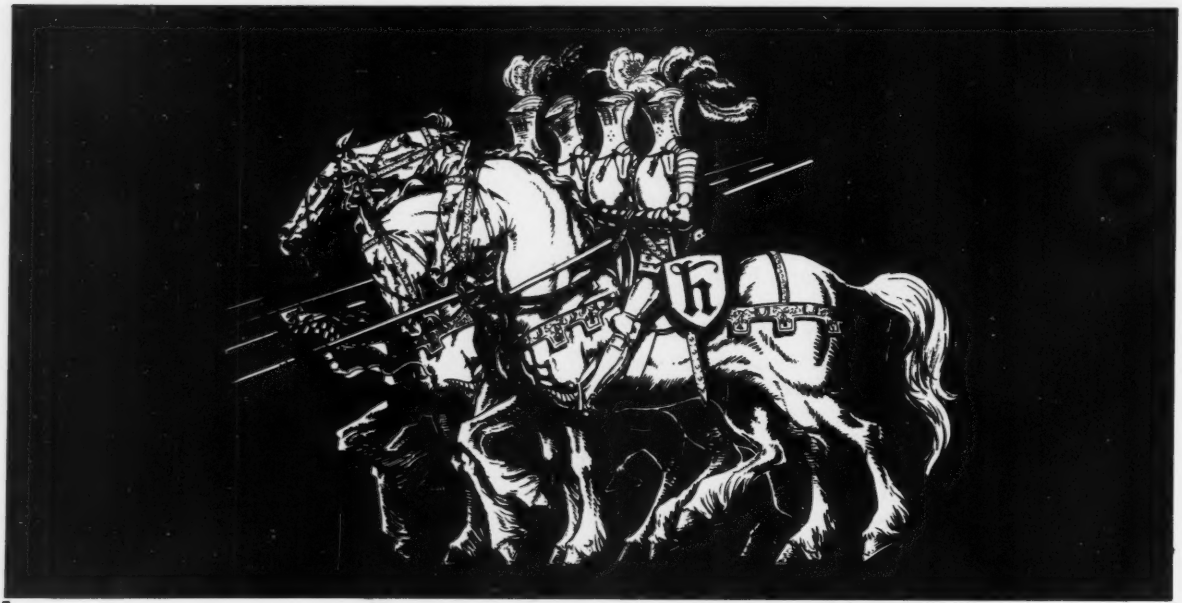

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